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The Heyford Express-

Details of wing cells, landing gear and nose, showing the peculiar arrangement of the giant British nigh bomber, the "Heyford." Note the exceptional range of vision had from the forward turret.

by

JOSEPH V. COMPTON

European correspondent of POPULAR AVIATION *on technical matters relating to flight.*

OF GREAT interest is the new British super-bomber, the "Heyford Express Night Bomber" recently put into production. It is the last word in British military planes as viewed from the European standpoint. Fifteen of these machines were ordered about nine months ago, on the original contract, while more recent orders have brought the total number up to nearly forty as replacements in the Royal Air Force night bombing squadrons.

Saving time in the air and on the ground is one of the underlying principles in the design of these large biplanes. Speed, high attainable ceiling and rapidity in all the necessary ground work of refueling and reloading are combined in the Heyford. And, in addition to these qualities, is the fact that this bomber can defend itself as it flies by an ingenious arrangement of its armament.

Powered with two Rolls-Royce 525 h.p. "Kestrel" engines, it has a maximum top speed of 142 m.p.h. at an elevation of 12,500 feet. Cruising at 10,000 feet, 115 m.p.h., the Heyford has a still air range of 920 miles.

This design is in agreement with the military theory that "central shock," or penetration into the enemy's center, is now the primary aim of modern warfare. The old policy of nibbling at the edges of a hostile force has been abandoned in favor of the system of central shock which paralyzes and disrupts enemy activities at their very base. And in pursuance of this policy, the heavy bombing plane is now recognized as the most effective of all war instruments.

Such operations demand a bomber of great range, great weight carrying capacity and self-protective ability, and in these respects the Heyford excels. It is comparatively low-priced when compared to single engined bombers of the same weight carrying capacity and in addition, is cheaper to operate and requires a minimum number of men for its operation.

The Heyford has a range of 920 miles and can carry 2,800 pounds of bombs a distance of 510 miles in 4½ hours. It costs approximately $70,000 against an estimated cost of $400,000 for single-engined bombers of the same bomb carrying capacity. It is estimated that two Heyfords are the equivalent of eleven single-engined bombers operating over a fixed range of 510 miles. While it is true that the single engined bomber will be from 10 to 20 m.p.h. faster, it will only carry 500 pounds of bombs and therefore, a great number of the small machines will be required for delivering the same weight of explosive with the further objection that a convoy of fighters will, in most cases, be required for their protection.

In the accompanying table, taken from the *Handley Page Bulletin*, a comparison is made between a Handley Page Heyford and a typical single-engined bomber, over a constant range of 510 miles. (Table on next page.)

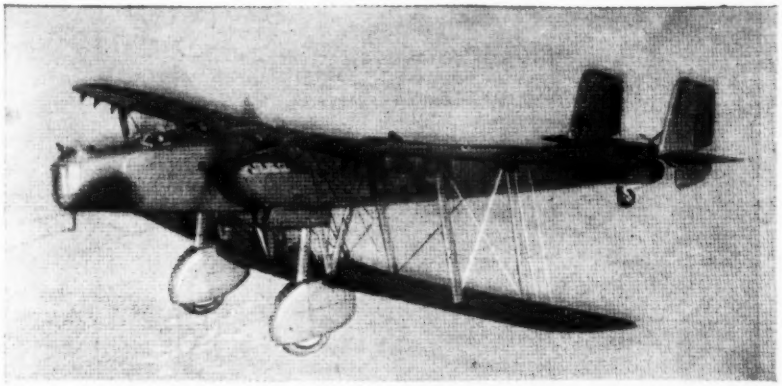
From the standpoint of operation, the large plane provides a steadier gun platform and a steadier bombing platform, both of which indicate a greater accuracy of fire and bombing. Again, a small airdrome, such as the majority of the airdromes found at the scene of action in actual war, is limited in respect to the number of bombing planes that can be accomodated rather than to the size of the planes. Therefore, it is obvious that in such fields, it would

The metal turret, with its gunner, dropped below the fuselage for repelling attacks from below.

Giant Night Bomber

THIS Handley Page night bomber marks a new era in the construction of this arm of the British air service. Both in respect to its size, armament and bomb carrying capacity, it stands alone in its class.

One of the most remarkable features of the "Heyford" is its ability to "fight as it flies," thus doing away with the necessity of an escort of pursuit planes. It can fight and repel attacks from any side or any angle while flying straight toward its objective.



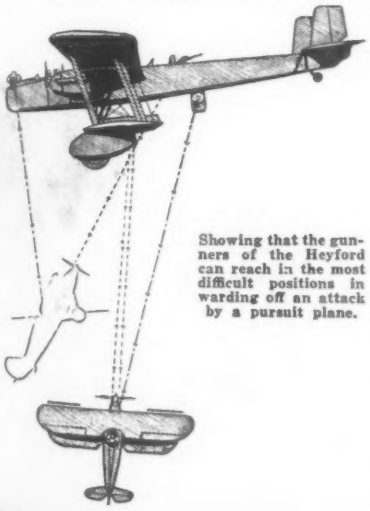
The Handley Page "Heyford" in flight showing the marked characteristics of this biplane. The lower wing is dropped far below the fuselage and as near the ground as possible to gain the advantages of ground compression and slow landing.

be easier to accomodate two large bombers than eleven smaller planes of equal capacity.

In regard to effectiveness in terms of artillery power, the *Handley Page Bulletin* states that a 250 pound British aerial bomb carries 25 per cent more high explosive than a 15 inch artillery shell so that the comparative destructive effect of a single load of bombs in the Heyford would be equal to approximately fifteen 15 inch artillery shells.

A bomber flies on a predetermined course in the shortest possible length of time—usually a straight course—in spite of all opposition. In short, they must be able to fight off all attacks while flying on this course without deviation or maneuvering. To this end, the Heyford is amply supplied with movable machine guns that can reach in all directions, to the front, to the rear, above and below, something that cannot be accomplished with a single engined bomber. The latter can be attacked from beneath and on the tail without being able to reply effectively.

The defensive armament of the Heyford consists of three screened machine-gun emplacements, one of them in a metal turret which may be let down beneath the fuselage when an attack is threatened from the rear or below. Again, the top of the fuselage is level with the top of the upper wing which gives excellent vision in all directions. And it may be said that the Heyford does not make an unusually big target for the ground anti-aircraft fire as its span is only 75-feet, not much greater than that of the single-engine type. This is one of the benefits of biplanes.



Showing that the gunners of the Heyford can reach in the most difficult positions in warding off an attack by a pursuit plane.

TABLE 1. COMPARATIVE DATA

Items	Handley Page Heyford	Single-Engine Bomber
Total bomb load carried	2,800 lbs.	500 lbs.
Time taken in hours	4½ hrs.	3½ hrs.
Approximate price	$70,000	$40,000
Crew per machine	4 men	2 men
IN OPERATION		
Comparative number of planes	2	11
Investment in planes	$140,000	$440,000
Equivalent personnel	8 men	22 men
Operating altitude	13,000 ft.	15,000 ft.

At its normal altitude of 13,000 feet, it is practically immune from ground attack on night missions.

Its mechanical features are quite interesting. First of all, the lower wing is placed quite close to the ground to gain the benefits of ground cushioning in reducing the landing speed. Again, wing slots are fitted so that the total effect is an extremely low landing speed, so desirable when much night flying is done. In spite of its size and weight, the biplane principle gives excellent maneuvering power and easy pilotage.

Every facility is provided for quick refueling and reloading on the ground. Men standing on the ground at the level of the lower wings, snap jointed bayonet pipes into connections on the lower wing and the gasoline gushes up under pressure into the fuel tanks located in the upper wings.

At the same time, the armorers are loading the bomb-rack in the center section of the lower wings, while the engine mechanics have let down the cowlings for making the necessary adjustments on the engines. The propellers are placed so high that there is never less than eight feet clearance from the tips of the blades to the ground, hence the engines can be idled without endangering the armorers working on the bomb-racks.

The ability to refuel and reload quickly is of the greatest possible advantage in operations requiring repeated attacks by the bombers. In many cases, the ground time determines the total weight of explosives delivered on an objective within a limited time, and in this respect, the constructors have taken a leaf from the schedules of truck transfer operators.

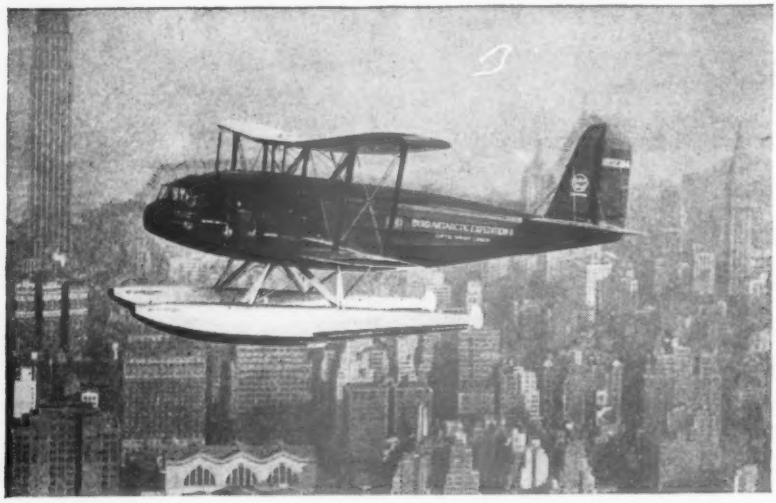
And another point is the choice of a biplane for this sort of work, a decided advantage in flying over enemy terrain. Since the biplane type presents approximately half the horizontal wing area displayed by a monoplane it is not so likely, therefore, to be picked up by enemy search lights. Again, we have the advantage of better stability with the biplane structure, together with a correspondingly steadier "platform" when delivering the bombs. The biplane may be somewhat less efficient, from the point of fuel consumption, but this is offset by larger gains in other equally important characteristics. All of these points of superiority were evidently proved by an earlier monoplane super-bomber built about two years ago.

It will be seen that the engine nacelles, like the fuselage, are placed tight against the upper wing without any space between the wings and the nacelles. This brings the center of thrust comparatively high in respect to the wing group but almost coincident with the center of the fuselage.

At first glance, it would seem that the high center of gravity would lead to considerable "top-heaviness" after the bombs were discharged, and that this would make taxying difficult on rough ground. However, it is likely that this is offset by the extremely wide track of the wheels.

END.

Floats Used on Byrd's Condor Plane



Admiral Byrd's Condor in flight over New York City, equipped with Edo floats for making landings and take-offs from water or ice. Because of the float design, this large heavy ship takes off in a surprisingly short run.

ADMIRAL BYRD'S Curtiss Condor is the largest seaplane in this country and probably the largest of its type in the world. But despite its 17,800 pounds of gross load, it took off in 18 seconds at 149.7 m.p.h.

Admiral Byrd not only intends to take off the water on these Edo floats but will also land the Condor on the snow and ice at Little America. Seaplanes have been landed with safety on ice and even on solid ground, in the past, but to land the huge eight ton Condor on the keel of its floats is a bit daring.

This Condor is fitted with two Cyclone engines rated at 710 h.p. each and turn Smith controllable pitch propellers of the three-bladed type. The floats are the Edo Type T-16,800 having a length of 32 feet, 4 inches, and a beam of 57 inches. The total displacement of the floats, totally submerged, is 16,800 pounds each. Each float weighs 650 pounds which gives it a submerged displacement of 25.8 pounds for each pound of structural weight.

During the tests, the ship took off repeatedly in from 18 to 22 seconds in the face of a 12 m.p.h. wind and propeller spray was entirely absent. The floats ran clean and steady at all times and the tendency toward damping out longitudinal oscillations on the water was so great that the ship could take off with absolutely free elevator controls from an idling start.

As an element of safety and as a reinforcement that gives tremendous strength to the hulls, they are divided into 21 water-tight compartments. It will be possible to take off with three of these compartments flooded and the ship will float with nearly half the float displacement voided by leaks.

Byrd's Antarctic plane will be reproduced in full colors on the front cover of the next issue of POPULAR AVIATION accompanied by 3-view drawings.

Here is one of the floats of Admiral Byrd's Condor, showing the clean lines of the hull and the form of the bottom surfaces which must resist both water and ice. They will carry about eight tons in service.

F. A. I. Allows Settle's Record

THE Contest Committee of the National Aeronautic Association has received word from Paris that the official report of the N. A. A. has been homologated by the Federation Aeronautique International (F. A. I.) and that the Settle-Fordney flight is now recognized as the official world altitude record.

The checked and accepted figures for the altitude is now 18,665 meters or 61,236,691 feet. It will be remembered that the instrument readings were somewhat higher than this.

Prior to this flight, the Russian balloonists Prokofiey, Birmbaum and Gudenoff reported that they had reached an altitude of 19,000 meters or 62,335.77 feet. More recently, the ill-fated Russian balloon "Syrius" was reported to have reached an altitude of more than 67,000 feet. However, in the case of these Russian ascents, there was uncertainty as to whether suitable records would be submitted to the F. A. I. because Russia is not a member of this association, which for many years, has certified all important records. Thus, the Settle-Fordney flight is alone officially recognized.

Some Cat — Some Drop

FLOYD NEWTON, League City, Texas, tells us of an incident that proves a cat has nine lives—no more.

In 1932, a full grown house cat was provided with a three-foot parachute and was dropped out of a Curtiss-Robin at an altitude of 1,000 feet. But an accident happened, for when the prop wash struck the chute, it pulled a wire out of the harness connection, giving kitty a full free drop of 1,000 feet.

This cat is still living and was unhurt in any way though it was stunned directly after the fall. This was purely accidental as there was no intention of hurting the cat.

Salt Cooled Valves

ONE of the greatest improvements made in aeronautic engine design, particularly for air-cooled aviation engines, is the "salt-cooled" valve. These valves are manufactured with hollow stems and heads and the hollow portion is then partly filled with metallic sodium—a very soft metal that melts at a comparatively low temperature.

After the engine warms up, the sodium melts and adheres to the hot interior surfaces of the valves, while the agitation of the liquid sodium transfers the heat taken in through the head of the valve, or stem, and is then transferred to cooler portions.

Previous to the invention of salt cooling, a great deal of trouble was experienced with the valves of air-cooled engines and super-compression engines due to the heat which burned and warped the valves.

Healy is Still in the Service

by CARL B. OGILVIE

Captain James A. Heay, a World War Ace with five officially credited victories, tells his interesting experiences to the readers of POPULAR AVIATION via the author. Capt. Healy is, at present, commander of the 42nd School Squadron, Kelly Field, Texas.

JAMES A. HEALY, in a misguided moment of his college days, decided to become a lawyer; but the war changed all his well-laid plans and he became an Ace pursuit pilot.

Today, he is holding down the exacting and responsible task of teaching young Americans how to fly at our "West Point of the Air," Kelly Field, Texas. Captain Healy has been in the Air Corps since 1917; he is not an instructor nor classroom lecturer, he is in command of one of the crack squadrons, the 42nd. School Squadron at the Air Corps Advanced Flying School.

If you are inclined to think Captain Healy gave up the joystick for swivel-chair strafing, you are doing one of America's outstanding Aces of the World War an injustice. Jim Healy is capable of putting on a one-man show in the air in either branch of the Air Service—heavier-than-air or lighter-than-air. He can perform any duty required of an airman in both branches of the Service. He is rated as an Air Pilot, Air Observer, Airship Pilot and Balloon Observer.

Captain Healy, born at Fort Leavenworth, Kansas, was just 20 years old when the United States declared war against Germany. He had received his A. B. degree at St. Peter's College, Jersey City, New Jersey, three years previously. That was in 1914, when Germany ruthlessly invaded Belgium in her unsuccessful right-wheel movement to capture Paris. When America tackled its Herculean task of organizing and training an air force, Healy lived in Jersey City and was studying law at Fordham University.

He enlisted in the U. S. Army, Signal Corps, air section, in July, 1917, and received his preliminary training with the R. F. C. in Canada. By September, 1917, he was a first class private of the Signal Enlisted Reserve Corps. In the middle of December he was sent to Roomsey, England, for training and was commissioned a second lieutenant of the Air Service on January 28, 1918. From Issoudun, France, on April 2nd the second lieutenant reported for duty to Major G. H. Bonell, Commander of the 147th Pursuit Squadron at Epiez. The squadron was assigned to the A. E. F. First Army and reached the Front at Toul on June 1st.

But this brown haired lad was not to remain a second lieutenant any great length of time. In a little over two months he was commissioned a first lieutenant in the Air Service of the National Army. He became a flight leader of his squadron, whose insignia was a cartoon of a rat-terrior.

Just three months later, on September 15, 1918, he was made a captain and squadron commander. Captain Healy saw approximately one year service in France and seven and one half of those months were served on all the different American fronts. He shot down at least 10 German planes, but was officially accredited for only half of them.

Captain Healy told me that when 147 reached France it was temporarily

Capt. James A. Healy, a World War Ace and "an ace of a man," according to the Kelly Field cadets.

disbanded. Its pilots were sent for additional training to the 3rd Aviation Instruction Center at the American camp, Issoudun, France. Here the Americans learned to fly Nieuports 23's and 27's with 150 h.p. Le Rhone motors.

"While at Issoudun," said Captain Healy with a broad boyish grin, "I had considerable difficulty in formation flying. That is, I made my instructors think so. I couldn't resist the temptation to drop out of formation and go flying down to within about forty feet of the ground at German prisoners working on the roads. I liked to see the frightened Heinies run.

"Another prank I enjoyed, and one for which I deserved to be severely reprimanded, was diving at cows and sheep grazing in pasture lands. But I was young, and I liked to see them run across the meadows. For this weakness my comrades gave me the nickname of 'The Wolf.'"

I reminded Captain Healy of receiving his orders for active front line service on the Toul sector.

He smiled wryly and said: "You know, Ogilvie, it was remarkable in those days how airmen in France made Paris a city of call. No matter where he was going, or how quickly he was supposed to get there, he *always had to go* by the way of Paris."

I said: "I know the answer. You forgot Toul and went to Paris."

Captain Healy elaborated with a chuckle. "You know, Paris isn't such an easy place to get around. Strange, wasn't it, how I got lost and couldn't find the depot until my money had just about given out? It took me at least two weeks to find myself.

"The Toul sector was, as you know, more or less of a training section for both the Allied and German Air Services. Consequently we did not see very many Germans in the air and likewise they didn't see very many of our boys while I was there."

After a month of preparation, the squadron was transferred to the large French aviation field about five miles north of Toul. Here the Americans started their patrols in earnest, flying regularly on an average of six hours a day. I suggested the captain tell of his first flight from this field. He confirmed my suspicions by saying:

"I'll never forget that as long as I live! I was one of a five-plane formation, flying at about 15,000 feet. We were headed over the town of Pont-a-Mousson where a German anti-aircraft battery was noted for its speed and accuracy in bombing planes. And could that battery shoot! All of a sudden an Archie shell burst about 200 feet to the left and under my Nieuport "28."

"Now some kiwis will think that 200 feet is a miss-as-good-as-a-mile. So did I, for a moment. But it wasn't. I soon found that out! The force of the concussion of the exploding shell threw my plane over onto its back. And there I was, upside down and not particularly enjoying the glee of the Boche gunners below. After considerable difficulty I managed to right my ship and believe me, I gave her the sauce and got away from that part of the world as quickly as I could."

Two weeks later, Jim had his first

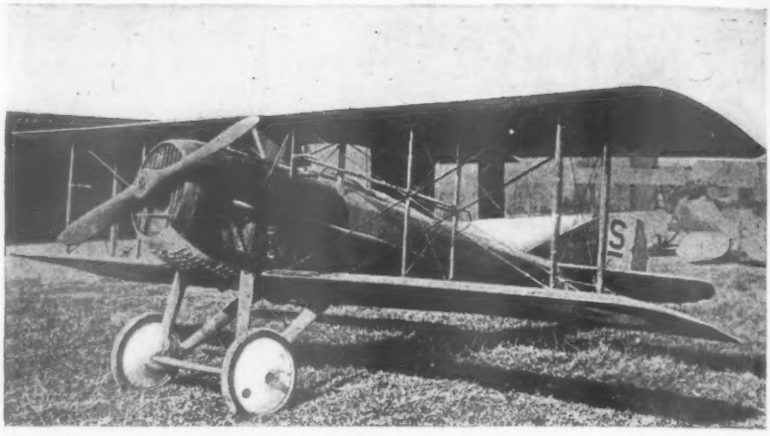
go at a German plane. He was out on an early morning patrol and spied a Hun two-seater photographing plane hovering over Nancy. Piquing off, Jim went after the Boches. The pilot and observer were so engrossed in their work that they failed to see the approach of Healy's Nieuport. He withheld his fire until within less than one hundred yards, then he got one of the greatest disappointments of his life.

"Of course I was all keyed up for the scrap," the captain said. "It looked like an easy one as the Boches evidently hadn't seen me coming after them. With all the excitement of a novice, I pressed the control levers of my two Vickers machine guns. Then I sat and stared at the guns. To my utter consternation all I heard was a dull hollow click. My guns had jammed! Not one, but both! Lady Luck didn't give me a break that day.

"Before I could correct the defective feed the German plane had observed my presence. It quickly dived toward its own lines and the observer opened fire at me at the same instant. I made a few feints at the two-seater to make them think I was going to attack, and all the while trying to fix my guns. I couldn't; so, keeping out of range, I chased the enemy plane back across the lines."

When the Germans made their final attempt to capture Paris in the middle of June '18, Squadron 147 was rushed to the Marne sector. Due to the illness of the squadron's C. O., Healy was made a first lieutenant on June 17th and became commander of Squadron 147.

Jim Healy learned that the American Air Service had only one pursuit group, one observation group, and one bombardment group in active service. It was necessary for the American Air Service to be assisted by three British squadrons of pursuit and observation planes combined and two French observation squadrons. Opposing the Americans, the Germans had approximately thirty pursuit and half as many observation and bombing groups.



The SPAD, one of the best known of the wartime combat ships, many of which succumbed to a bullet through the radiator, probably the greatest number of casualties were due to this mishap.

"When we flew in our usual eighteen plane formation," explained the Ace, "we usually encountered forty to fifty enemy planes. But we fought them and gave them Hell!"

During the drive on Chateau Thierry, Squadron 147 was almost completely wiped out. It lost eighteen of its twenty-two flying officers. Part of these losses were due to the hazardous work of fighting overwhelming odds, trench strafing, shooting up troops and supply trains on the roads. The official record of the squadron gives it a credit of 103 combats and 31 official victories.

I asked Captain Healy to tell about his aerial battles with German pilots. He said:

"Well, there's always the pursuit pilot's first victory and his last. If luck is with him and he keeps his head, there is also the fifth victory which makes him an 'Ace.' I got my first Boche on July 20th, 1918.

"I decided to make a voluntary solo flight in order to determine if certain towns behind the enemy lines were being destroyed by our artillery fire. It was just about dusk when I reached an altitude of 15,000 feet. The sun had sunk low in the West and the flashes of the French 75's resembled fireflies on the earth below me. Just across the lines I could observe several towns burning.

"I was so fascinated by the beauty of the sight that I forgot that an enemy plane might be around. Then, suddenly, I heard the put-put-put of Spandau machine guns. Looking around quickly, I saw three Fokker pilots having the time of their lives shooting at me. I heard bullets ripping and tearing through my wing surfaces, slapping into bracings and struts.

"It may sound funny to you, but for the moment I was so startled I forgot I had a pair of twin Vickers mounted just in front of me. All I could think of was doing the quickest maneuver I could. I pushed the stick forward and ruddered; my ship went into a half spin. Quickly turning I jerked the throttle full on and dived towards our lines.

"Then all of a sudden I realized that I'd never be decorated for this type of bravery; besides I vaguely recalled that it was a pursuit pilot's job to fight. I had found that I could out-maneuver the Boche pilots—at least keep their lead out of my carcass. Although there were three of them I turned and gave battle to the first one that came at me. I let him have a long burst. One of my bullets found his gas tank and he went down in flames. When I looked around for the other two they had gone."

The next day, a German scout plane nosed up to Healy's level. The two planes began circling, each maneuvering for a position of advantage. Jim saw the German thumb his nose. The Pfalz pilot proved an exceptionally fine pilot and an uncomfortably good shot. But with a quick surprise maneuver

(*Continued on page* 268)

—*U. S. Signal Corps Photo.*

One of Captain Healy's many victories—a German plane (probably a Fokker D-VII) shot down behind the American lines.

Yes–Middle Aged Men Can Fly

by T-2003

After many careful investigations made by the author in which the opinions of many flying instructors were obtained, he comes to the interesting conclusion that men of all ages can fly satisfactorily. It depends more upon the type of man than upon his age.

"WHERE," asks the middle-aged man, a trifle bewildered, a bit uncertain and much confused by the varying statements of "pro's" and "anti's",—"exactly where do I stand in this matter of learning to fly? Could I ever by hook or crook become a pilot?"

"The very idea—at your age," scoffs the wife of the partly bald would-be pilot when he announces his ambition, yet feeling just a tiny bit proud of his aggressive spirit.

"Youth often has its handicaps," concludes the experienced squadron commander of an army air squadron, who is nursing a dozen new pilots through their first years of tactical flying, with the help of several older fellow officers. "These reliable stand-bys of mine know exactly what they can and can't do with, and to an airplane, and never ask themselves or their ships to do the impossible or to defy the laws of aerodynamics, stresses, chances or nature."

"You're wrong, skipper," interrupts an *ex*-pilot of World War fame. "*We* used to look for the youngsters in our outfits. Adaptable to new ideas, not too set in their ways, y'know."

"It was the band extending from 16 to 25 years that defended present conventional aviation methods from invasion," stated the editor of Airy Chat, in recent proof of the *inadaptability* of youth to new ideas.

"Flying Cadets," reads the Army Regulations on the subject, "must be between the ages of 20 and 27 years."

Therefore, you middle-aged-would-be pilot, no one blames you a bit for hesitating to plop down the hard-earned dollars and embark on a career in the air. However, if you have the courage to read on, and the further courage to admit that you're no longer young but are a bit different than you were 20 years ago, you'll probably have the courage to go right on and take that flying course.

Admit, now, that you are different than you were in your youth. Then the author will concede one point—that you are also different from many others of your age who would unqualifiedly, firmly and hastily say "No!" to any suggestion that they should learn to fly.

You have something they lack, not necessarily courage—for that is too indefinable a term—but the urge to try new things, to explore beyond the horizon, to see what makes the wheels go around. Yet you lack something the youngster has. Your mental processes are slower, generally speaking. On a terrifically bumpy day you may not enjoy a forty-minute battle to keep the wings level and the nose on the horizon as much as a younger fellow.

Metabolic tests and other searching physical tests, while probably necessary for naval and military pilots, are not necessary for the private flyer. Few middle-aged men could pass this test, who are perfectly capable of flying their own ships.

If you ask, "Well, what difference does that make?", I will answer "Very little in the long run," and then cheer you up further by conceding another point. You have a desire to fly to a much greater degree than your neighbor's boy, let us say, who has also said he wanted to be a pilot. Your very desire to fly at all proves that, for youth is chock full of all sorts of desires, most of them unattainable. The middle-aged man has discarded most of the desires which he knows have no chance of being fulfilled, and sticks to only those which he will work for and fight for, if he must. In other words, he knows what he wants.

So we see the M. A. M. dead set on starting a course of instruction. He is not kidding himself a bit; in fact, he probably wants a frank statement from the school he chooses as to his chances of successfully making the grade. He has heard so much of "flying being a young man's game" that he can hardly believe in his own ability to go solo some time in the future. Knowing himself, as just an average fellow, he discounts the reports he hears of this or that man getting his transport license at the age of sixty-two and feels that this oldster is one man in a million.

ANTICIPATING the fact that the would-be pilot of mature judgment wants the low-down on himself, as a class, the author has interviewed more than a score of instructors, heads of schools, civilian operators and Army and Navy authorities.

A letter from a civilian instructor seemed to express the general opinion of his class toward the student in his thirties, forties, and fifties. "I hesitate to say whether the young student makes the better pilot," it read, "because who can say whether Jones is a better pilot than Smith? In other words, how do you compare a pilot's ability as such?

"One thing I will say, in this matter, is that I would rather teach a youngster if I were an instructor, but would rather have a middle-aged student if I owned the school. I cannot encourage the old fellers by casting aspersions at the young 'uns, but the latter can learn a lot by watching the former.

"Isn't it obvious," said a Department of Commerce inspector, "that the middle-aged fellow seldom experiences the hero or show-off stage in his flying career? As we know, from the time a student graduates until he has piled

up some hundreds of hours in the air, this is generally the most dangerous period of his life. Yet I seldom have occasion to get after any of the flying gentry older than about 36-37 years.

"As a class they give me little trouble by breaking flying rules and it's the same, I believe, in other districts. I'll make one exception, though. The rich sportsman, or should I say 'sport,' given to high powered cars, super-speedboats and high pressure living, who has finally taken to flying for adding more thrills to his thrill-jaded self, is in hot water about half the time. But he's not numerous, as a class."

A chief instructor at a well known flying school near New York obligingly went over his class records for me, and together we found the following facts:

1. Students past the age of 34 took 1¼ times the dual hours that were necessary for students below that age, before they took their license test. Most of this was in landings.

2. Of 18 older students, none flunked the Department of Commerce tests. Of 42 younger ones, 4 were returned for more dual hours before the inspector passed them.

3. Very few older students failed to complete their course, while a much greater number of youngsters quit for one reason or another. These reasons could not all have been financial ones. Does it show that the older bird has more stick-to-itive-ness in his system?

"I HAVE no preference concerning ages of students," stated an instructor from Georgia. "Invariably the older student means more work for me. He catches on more slowly. In recovery from tail spins, for instance, he must be shown the process three times to the youngster's two. All of which means climbing back to altitude and that takes time and time means money. Landing means that I must take special care, as the older student, especially past the age of 45, is prone to level off too late for the first four trials and after that to level off too high, until he settles down to normal landings.

"To compensate for all that, we have far less breakage with our older students than we do with our younger ones. The former always look around carefully before taking off, for instance. They learn everything quite thoroughly and don't go off diving at buzzards when they should be practicing figure-eights. They put themselves in the place of the school owner and co-operate very whole-heartedly in avoiding trouble, keeping appointments and landing on time."

"How about their quick thinking?", I asked. "Can they get themselves out of a jam as well as a youngster?"

"No, but to the same degree they seek to avoid getting *into* jams in the air."

This instructor's experience concerning the avoidance of breakage and wear and tear on equipment was paralleled by the Air Corps Tactical School, at Maxwell Field, Alabama, recently. At this school, experienced army air officers take a post-graduate course in air and ground tactics. The flying part of the course consists of all kinds of military air tactics four afternoons a week. With thirty-five pilots this means a large number of air hours for the nine months' course.

Last year, in the 1932-1933 class, the average age of the pilots at the school was about 40 years. In that whole course, not one of the Boeing pursuits, Curtiss attack planes, Thomas-Morse observation jobs or Keystone bombers suffered as much as a broken prop, blown tire or broken tail skid.

"Think a class of kids could have set a record like that?" proudly asked one of the school's instructors, himself a World War bird.

These were not students just learning to fly, of course; but it shows the inherent reliability of age.

Charles Dickinson, aged 76 years, who began flying at an advanced age. He is now considering a flight across the Pacific.

However, thought the author, it might not be a bad idea to get the army's official attitude towards age in students. Accordingly, I inquired at the Air Corps Training Center, Randolph Field, Texas, as to their ideas on the subject.

This complete military flying course takes one year. It supplies the Air Corps with pilots. These pilots must all come up to a certain standard if they are to work together in the close teamwork necessary in the tactical squadrons to which they go after graduation. A laggard would throw the whole squadron out of gear. So with a laggard at the school. With about 700 students starting the course each year, it would be almost impossible to make provision for the student who required one and a half or two years to complete the course.

IT HAS been the army's experience that many flying cadets over the age of 27 require a greater amount of instruction than can be given them in the school's course. As long as many more younger cadets can be obtained from civil life than there can be trained there, the army has set the Flying Cadet age limit at 27.

It must be remembered, however, that the army's school turns out professional military pilots and Air Corps officers. The officer part of it also influences this age limit, as there is no desire to build up a corps, even in its reserve, of middle-aged second lieutenants, a grade which is more appropriate for men under thirty years of age.

Civilian schools do not turn out military pilots and few of them turn out professional pilots. The greater number of students at civilian flying schools intend to be amateurs. Close formation, aerial gunnery and bombing, or pursuit tactics, will never have to be indulged in by them. Bad weather flying need not be performed on schedule by the amateur, although a great number of them could do it with every success.

It will therefore be seen that the army's age requirements for student pilots only fit their case and have little application to civilian schools.

"I have been piloting the same man for the past ten years," said a pilot whose air-enthusiast boss was well in his fifties. "The first month I worked for him he asked for some instruction; not for the purpose of going solo, but so he could relieve me in the air on long hops. He learned readily enough but going further, to landings and take-offs, he got a set-back.

"The ship we had then was full of blind angles. It was almost impossible to look around before taking off and coming in over trees or buildings was terrible. The boss never evinced any desire to do anything but straight air work. Then two years ago he got this new bus after a succession of ships which were slight improvements on all previous ones. This last one is well-nigh perfect.

"The old man couldn't wait until he'd made some take-offs and landings in it and he did them perfectly. He even delights in flying for a half hour at a time in a cloud strata and gets a kick out of instrument flying. However, he has no desire to solo."

Still another pilot-instructor had this to say of the middle-aged student—"they do not vary from those of younger age to any greater degree than all students vary among themselves. The older ones, as a class, take more dual instruction, but they all *want* it. The younger ones sometimes resent too much dual time.

"I could figure my costs more accurately if I had nothing but older students, as they generally run along the same pattern and act consistently. Outside of that, the old ones are no different than the youngsters, as a

(*Continued on page* 266)

Eliminating the Peril of Fog

by MEL WHARTON

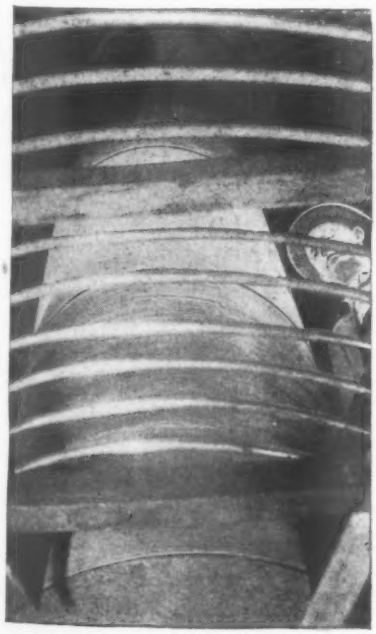
The electric fog eliminator described here, marks a great step in advance for safety in flying. Press a button and—whoof—the fog disappears for a considerable distance around the airport.

FOG— arch enemy of all navigation, especially in the air—is taking his last curtain call.

At Whittier, Calif., a small city some 15 miles east of Los Angeles, rises a tall, derrick-like device that has greased the skids for fog's final fade-out. The machine emits electrostatic waves into the surrounding atmosphere, causing the fog particles to condense and fall as rain. Under actual field tests with heavy fog conditions and in the presence of this writer, the "electrodrome," as it is called, has successfully dissipated the enveloping fogs throughout a radius of approximately 1½ miles!

Officials from the U. S. Department of Commerce are, as this article is being written, inspecting the apparatus with the view of possibly recommending the placement of similar electrodromes at all important airmail ports and at intervals along the heavier-trafficked air lanes.

Curiously, the inventor, Mr. William Haight of Los Angeles, scientist and engineer, was seeking to produce fog when he discovered the unique moisture precipitating ability of his machine. Frost is a natural enemy of the California citrus groves and Haight was endeavoring to manufacture artificial fog to protect the delicate groves when he found that he was able to disperse fog much easier than he could create it.



This is the high-frequency Tesla coil that builds up the operating current to about 500,000 volts. This coil is placed in the upper part of the tower.

He, therefore, concentrated his attention upon the fog dispersion angle with the result that he was able to develop a machine, entirely practical in its economies, that seems likely to write a new history, not only for aerial navigation but for all kinds of motored travel where fog has long been considered a tragic menace.

The device, called an "electrodrome," utilizes a 130-foot-high derrick from which electrostatic emanations are sent into the air about. The theory, long attested by science as valid, is that the upper air strata consists of positively charged particles of moisture; the ground being negatively charged. What the Haight machine does is to impel negative electrostatic electricity into the fog about the electrodrome. These negative bits of electricity have the ability to charge some of the moisture particles with some of their own minus charge.

The result is that the positively charged fog particles rush to the negatively and artificially charged moisture particles (unlike charges attracting) to form drops of rain that, by their own weight fall to the ground. The effect begins close to the electrodrome and gradually works its way back to a distance of approximately 1½ miles where, apparently, the effectiveness of the operation ceases, at least for the amount of power and particular number of cycles utilized by the Whittier station at present.

To produce this electrostatic electricity, there is concentrated at the Whittier electrodrome the various condensers, rotary-sparkgap for regulating frequency, transformers, a Tesla-type coil, electrodes and an automobile motor for producing the power needed at the plant.

Repeated tests have shown that the operation of dispersing fog is most effective at about 600,000 cycles—though work is done all the way on a range from 500,000 to 1,500,000 cycles. The machine is capable of developing 500,000 volts, but only a fraction of this voltage is found necessary. Confounding electrical experts, is the small amount of power needed to perform the seeming miracle of fog dispersion; only 4½ horsepower being required. The electrical waves are sent into the atmosphere from the points of an electrode protruding skyward from the top of the electrodrome housing on the 130-foot mast.

"The fog will remain at its 1½ miles radius as long as the machine is in operation," states the inventor.

"We have been considerably surprised at the small amount of energy apparently necessary for fog dispersion. Thus far, we have worked on eight heavy fogs and it has never taken more than 22 minutes to roll back a fog 1½ miles. A clearing is bored right through the fog and up to the stars. It is rather amazing to watch the stars begin to shine through what was, only a few minutes before, a blanket of black fog.

The 130-foot tower, or electrodrome, from which the fog dispelling electrical waves emanate. A tower of this type at every airport would avoid difficulties in bad weather landings.

"The acceptance, on a wide scale, of such apparatus would seem to me to go a long ways towards taking the danger out of air flight. An electrodrome at every air terminal would make it possible for a pilot to land under any conditions of surrounding fog. If a pilot were flying above the fog bank, it would be easy for him to spot the airport lights shining through the clear area.

"With a string of electrodromes put at intervals—say every 10 miles across the country along important air routes—the dangers to aerial navigation would be vastly mitigated and one of the gravest perils to air flight reduced to an ordinary contingency. Passengers are quite universally afraid to venture into the air during foggy nights and days. It might not be too much to expect a swift increase in passenger travel if the prospective air passenger

could be assured his landing fields would always be open."

According to the Haight theory, electrical circulations flow about the earth between the two magnetic poles, rising and dipping with the contours of the earth's crust and also, for other reasons not as yet fully understood even by science itself. This flow is much like that of water over rocks, believes Inventor Haight. When this flow of electricity between earth and the upper atmospheric strata ceases, we see clouds, fog, rain, sleet and snow, he says.

The theory was first put to laboratory test in the science department of Occidental College, Los Angeles. An airtight glass box was constructed into which any degree of atomized moisture could be sprayed at will. On the bottom of the box was an iron plate simulating the earth. Outside and above this box was suspended a metal ball, charged with positive electricity from a static machine and used to represent the upper atmospheric strata. The ground plate was negatively charged. By varying the distance between the ball and plate, Inventor Haight found he could dissipate any artificial fog.

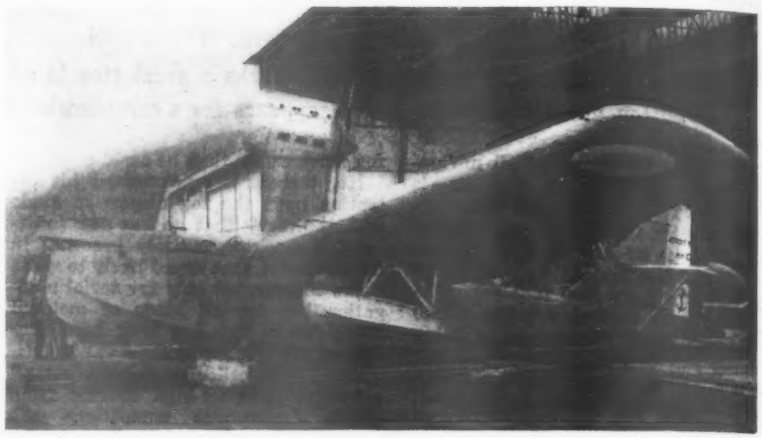
In addition to the vast possibilities in making air transportation safer and better, the electrodrome has a number of other important probable missions, believes Mr. Haight. For instance, at seaports where ships are often forced to remain in the open roadsteads tied at dock at anchorage waiting for a heavy fog to lift. By placing electrodromes at strategic intervals, Haight asserts any port so equipped may be kept fog-free at all times. The loss to marine shipping through insurance, inconvenience to passengers and interrupted schedules, runs into the millions of dollars annually, say statistical experts, to say nothing of the hundreds of lives lost yearly due to impaired visibility and collisions resulting therefrom.

The military value of the electrodrome may also be visualized. Imagine what such a situation would mean to cities like London and Paris which were heavily bombed during fogs when airplanes and anti-aircraft guns on defense were powerless to maneuver or aim accurately.

Another military feature is the uncanny ability of the electrodrome to "dry up" poison gas. Poison gas, such as is used in so-called modern warfare, must consist of moisture (in part) to be effective. "Dry" gas rises too quickly into the atmosphere to be of military value against ground troops.

By means of small portable electrodromes, operated either by tiny gas engines or by man-power, the inventor says experiments already conducted indicate that the electrostatic method of precipitating the moisture-laden gas gives every indication of reducing gas attacks of the future to almost total impotence.

Amiot Flying Boat Presents Novel Features



This is the new Amiot 110-S flying-boat, a new French production that has attracted a great deal of attention in Europe because of its excellent qualities. A new type of hull construction has added great strength to the ship.

FOR OVER two years, the French Amiot firm has been conducting research into the strains to which flying boats landing on and taking off from the water are subjected. The results of this research, which was made on the coast of Brittany at Caudebec, have now been expressed in a new coastal scout boat which presents novel features, both in the construction of its hull and its wings.

The most striking feature is the narrowness of the hull. It is less than five feet wide for a craft with a total loaded weight of 9,900 pounds. This extreme narrowness both cuts parasite resistance to a minimum in flight and makes landings on the water even in extremely rough seas, very easy. It cuts down the rebounding effect which is so serious a danger to hydroplanes.

In the tests, which resulted in the production of the new craft, the hull was loaded with a weight equal to the full weight of the plane and then dropped on the water from various heights and at various angles, with a series of registering manometers and tensiometers installed at various points on the keel and bottom.

The result of these tests showed that the greatest water pressure, and consequently the greatest need for strengthening, occurred not under the center of the hull, but right at the edges, although the keel touched the water first. As a result, the hull form of the new boat was narrowed down greatly to decrease these pressures, and at the same time its edges were specially reinforced with dural tubing.

Hull and wings of the new Amiot craft are formed of dural sheeting, double and riveted. The dropping tests showed that welded dural did not possess the resistance to water strain that riveted metal has, but that the ordinary form of riveting was not quite water tight as there was a tendency for the dural to warp around the rivets. Consequently, a new form of rivet, the "cork-rivet" developed by Amiot, was used. This type of rivet has a conical head, and a double conical shaft, narrowest at the center. The riveting is done by a special machine which, instead of by blows, forces the rivets into position with a steady pressure. The dural thus riveted shows no warping and is completely water-tight, even under pressure.

The wings of this novel machine are also made up on an original plan. They are composed of three main sections. The center section consists of an interior-braced box, supported by three longerons, air and water tight. The leading edge is also made air and water tight and contains the gasoline tanks. The trailing edge constitutes a third box, also tight, but without bracing and the three sections are assembled by screwing them together. The whole wing structure is thus capable of being taken apart, and each section alone is sufficient to support the whole machine while floating on the water, even if the rest should become waterlogged.

The Amiot 110-S is a three-seater, having double controls and two machine-guns mounted on a turret in the bow and a third seat with a pair of guns behind the propeller. The machine is provided with a single Hispano-Suiza 650 h.p. motor, and preliminary tests have shown a speed of over 125 m.p.h. with full load, with an extremely rapid climb, thanks to the elimination of resistance.

This type of flying boat has attracted the attention of airplane builders all over the world—the boat-hulled monoplane with its engine mounted above the center of the wings.

The first flying-boat of this type was the Dornier which was quickly followed by several Italian flying boats of this type, notably the boats used by Balbo last year on his long distance cruise. Then followed the Douglas, General and Fairchild boats in this country.

Orville Wright Interviewed

by JAMES FARBER

Orville Wright, co-inventor of the airplane and long noted among newspaper men as being the most difficult man on earth to interview, is stalked by the author with the following results.

OF ORVILLE WRIGHT, pioneer airman and his aversion to being interviewed, I tell. Of the meeting betwen a "home-town boy" who experiments in a laboratory and a "home-town boy" who experiments with words on a typewriter, I relate.

It all started one hot July afternoon in the office of John B. Rathbun who looks after the editorial destinies of POPULAR AVIATION and incidentally, after those of some of us who talk to you through these pages. We were fanning ourselves vigorously against a heat that was brighter than a Boeing P26A wing. Mr. Rathbun said:—

"You'd better see what you can do with Orville Wright. He ought to have something to say about aviation in its thirty-first year. We could use something like that after New Year's."

I realized I was up against it. I think he did, too, being an old time flyer who had more than once run across the world's first birdman in the early days. It was a prize assignment although the exact nature of the prize remains somewhat obscure. I had plenty of time to think about the matter coming back to Dayton in an Air Corps plane. And to plan the diplomacy with which to pierce the well-known Wright frosty reception of reporters of any description—even those representing influential papers.

I sat up there in the clouds for an hour and fifty-five minutes and tried to figure out just how to accomplish the near-impossible. Then, Wright Field hove into view and I still had little idea how to begin. Now that it is all over, I feel very daring about it and would now be quite willing to get chummy with Mahatma Ghandi on the subject of spring fashions for young men.

The first move against the unsuspecting—maybe all too suspecting—victim was a call at his office on N. Broadway, Dayton. It was calculated to be a surprise attack. The weapons were polite and respectful words and the shield and buckler, the name of POPULAR AVIATION. It was, I fondly thought a very good approach. I found myself disarmed by my own weapons.

Equally polite were the words which conveyed to me the idea that there was a big figurative NO TRESPASSING sign on the premises that applied particularly to newspapermen and would-be interviewers. I found myself dealing with an opponent who was wily in the ways of not meeting those of my ilk.

I then declared the Wright Laboratory to be in a state of siege and began sentry duty up and down the street and around the block in the hope of seeing my quarry step to the street from the safe sanctuary he could only enjoy until his office hours were over. All I wanted was just one glimpse and I would be off like a Wedell-Williams racer.

Walking around the corner on Third street, I passed the building that used to house the bicycle repair shop where the brothers Wright, toiled over their wheels and pumps and betimes over their conceptions of what might help man to fly. A barber shop occupies the building now. I wished that I could

Orville Wright favors us with a broad smile, one of the few seen in newsphotos. He is of a shy retiring nature.

get hold of a Wright bicycle and ride up to the front door of the laboratory . . . but, no, that might not work. Sentry-go was the solution.

But sentry-go was not the solution. Not even when I braved zero weather to climb a hill and ring Mr. Wright's doorbell in the evening did I find my vigilance paying any dividends.

After all, I didn't blame the inventor very much for his attitude toward the press. He told me one time the story of how several reporters descended on him, pried a story from him, then wrote it using their imaginations to the limit. In my own encounters with him, I had found him affable and genial, much different in fact from the impression he gives to the public through his inaccessibility.

It became apparent to me that if the readers of POPULAR AVIATION were to have any first-hand account of what aviation's first pilot was thinking about and seeing in the future at the beginning of the thirty-first year of flying, desperate remedies were in order. Accordingly, on a bright and cold morning (why must these sorties always be early on cold mornings?) I rose at an uncivilized hour, trekked several miles out to the Colonial mansion that Mr. Wright occupies in Oakwood, just outside Dayton, and took my stance.

I was informed at the door that the object of my call would not be down for some time, but that if I were to telephone at about 8:15 I might find him and that he might be persuaded to come to the telephone.

With this I had to be content. I tramped over to the Oakwood police station mighty glad to get in out of the cold. The wait was not a weary one. Police stations are interesting places as long as you are on the right side of the grill work.

Surrounded, then, by the members of the department then on duty, I put in my call. At length Mr. Wright came to the phone. He was very pleasant even at that hour when anyone is justified in resenting an intrusion on one's privacy. But he was very firm. He saw no reason to be interviewed. Felt that there were others more capable than he of commenting on aviation and its prospects.

You know the arguments I advanced—the same ones you would have used. It began to look like a losing battle. A very friendly affair, and conducted by each party with the utmost regard for the other's feelings. But a losing one for me none the less.

Finally, I banked all on a chance:—I laughed, and said:

"Aren't you even going to invite me to ride downtown with you, Mr. Wright? Gosh—"

"Oh," he said, "where are you?"

"I'm around the corner at the police station."

"Well," said the inventor good humoredly, "I'll finish my breakfast. You come around in about ten minutes."

I did.

We went back to the garage. The motor of his fleet little coupe was cold. We tried pushing the car out of the garage. It wouldn't budge. Mr. Wright got in and released the brake. I pushed the car containing the world's first flyer into the driveway. The engine came to life. Mr. Wright called:—

"Hop in."

I hopped in and we hopped off. We missed the green lights all the way down town. Take it from me, you couldn't teach Orville Wright much about driving a car. Or the joys and advantages of speed. He has a quick eye and a steady hand and enjoys

missing green lights about as much as any motorist.

He was not, he informed me, giving me a formal interview. He insisted that I should seek out others to talk about flying and its future. He indicated that he was relying on my discretion in reporting our conversation. He said he disliked being quoted because (due to the informality of interviews) reporters are not apt at accurate direct quotation.

I asked him if he took much interest in the transoceanic flights, endurance flights, polar flights and other events of like nature.

Oh, yes, he informed me, he kept abreast of all these things and was very much interested in them. He felt, however, that too much was done in this regard that was only to be classified as stunt work and that the greatest boost to aviation was the first Lindbergh flight. The others, he intimated, were not nearly so important.

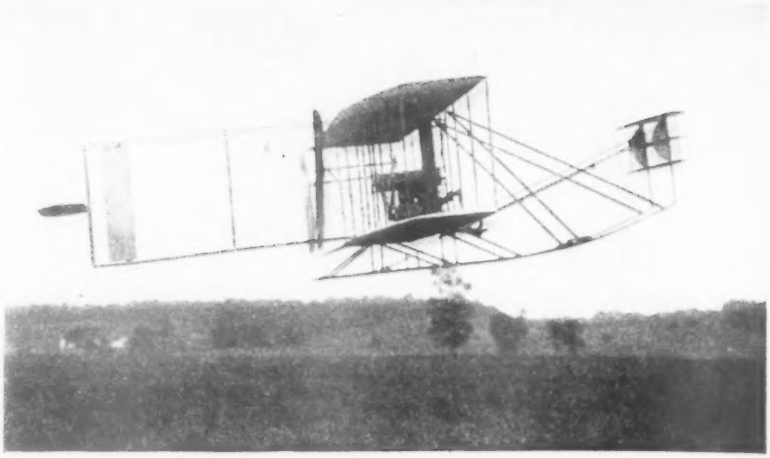
"But," he said, gravely, "I wish Col. Lindbergh wouldn't take too many chances. He's a valuable man and we need him. I'm worried about him."

Increasing betterment of the safety factor will be the greatest single inducement for the use of the airplane in commerce and rapid travel. He is not surprised at the tremendous strides in aviation, but rather, is very pleased with it.

In his quiet manner, Orville Wright on this occasion proceeded to dispell a myth that has grown up around the early days of the experimental work. Perhaps it would not be too much to say that the myth amounted to a great journalistic canard, foisted on the public by a press anxious to have an authoritative word to say on a subject about which it knew very little and had less means of learning.

The Wright brothers, the story has it, got their inspiration from a toy helicopter brought home one day by their father, Bishop Milton Wright.

Asked to answer yes or no as to the truth of this legend, Mr. Wright unhesitatingly branded it as untrue. After reflecting a while, he said:—



One of the early Wright powered airplanes in flight with Orville Wright at the controls. Note the forward or "canard" type of elevator and the skid type of landing gear without wheels. This plane was launched by a catapult.

"It would be very difficult to say just how or when we got our idea. Ideas are born without one knowing their precise origin. If any one factor started us on our work, it was the study of the life of that great glider experimenter, Lilienthal."

Otto Lilienthal lost his life during his experiments with a glider type monoplane which embodied the essential principles of the modern airplane.

"I brought home a book for Will to read," continued Mr. Wright. "We were both tremendously interested in it. We read as much as we could find on the subject and then started out to discover things for ourselves."

He seemed to pause as he recalled these things, and the shyness that characterized the Wright boys more than thirty-five years ago when they started their experiments and kept them secret for seven years, seemed to settle over him.

I asked him what sensations he had when he made the first flight.

"I don't recall any sensation," he told me. "I was so interested in whether the thing would work or not that I did not have time to think about it or gather any impressions."

I learned that it was pure chance that gave Orville the opportunity of being the first mortal to take wings. On those bleak sand dunes at Kitty Hawk the brothers had toiled for days setting up their machine. How many young men today would have the same indefatigable patience in the pursuit of an ideal that might easily end ruinously?

On December 14, all was in readiness and the brothers drew lots. Wilbur won. Before he could take off there was a slight accident and the controls were damaged. Wilbur had lost his opportunity. It was now Orville's turn and three days later they were once more ready. Orville flattened himself on the wing, unloosed the wire leashing the ship to the ground and, with Wilbur running along its side to hold the wing for balance, lurched into the air.

Man had flown. He was emancipated from the fetters that had shackled him to Mother Earth for fifty centuries of civilization.

Mr. Wright admitted that he would like to fly one of the sleek, fast planes that now travel overhead with such frequency as to no longer cause more than perfunctory craning of necks. He could not climb aboard one and fly it without some study, but he feels it would not take him long to learn.

"The last time I flew as a pilot," he recalled, "was in 1918. The De Haviland 4 was being built at Moraine just south of Dayton. They had the first D.H. 4 ever built and it was proposed that I fly one of the early biplanes alongside that ship in an exhibition. I consented and the stunt took place at South Field nearby. It was the last time I was in a plane as a pilot. I do not expect to pilot a plane again, however."

Thus spake the Zarathustra of flying. Not the Zarathustra of words and utterances, but the high prophet who

(*Concluded on page* 261)

Orville Wright (left) and Amelia Earhart examining a small bust of Wilbur Wright at a recent celebration of the 30th anniversary of flight.

The New Lockheed "ELECTRA"

THE "Electra" is a twin-engined low-wing transport having many refinements in design that permit of high speeds with a comparatively small power plant. It is noted as the first all-metal ship constructed at the Lockheed plant.

Among the prominent features of this plane are the wing submerged body, twin rudders, elevated stabilizer and elevators and the short compact fuselage.

THE Lockheed "Electra" Model 10A transport, contrary to the long continued practice of the Lockheed Aircraft Corporation, is of all-metal construction, but in many other respects it is typically Lockheed. The first Electra, built for Northwest Airways, is being prepared for flight tests, the figures given here being only conservative estimates.

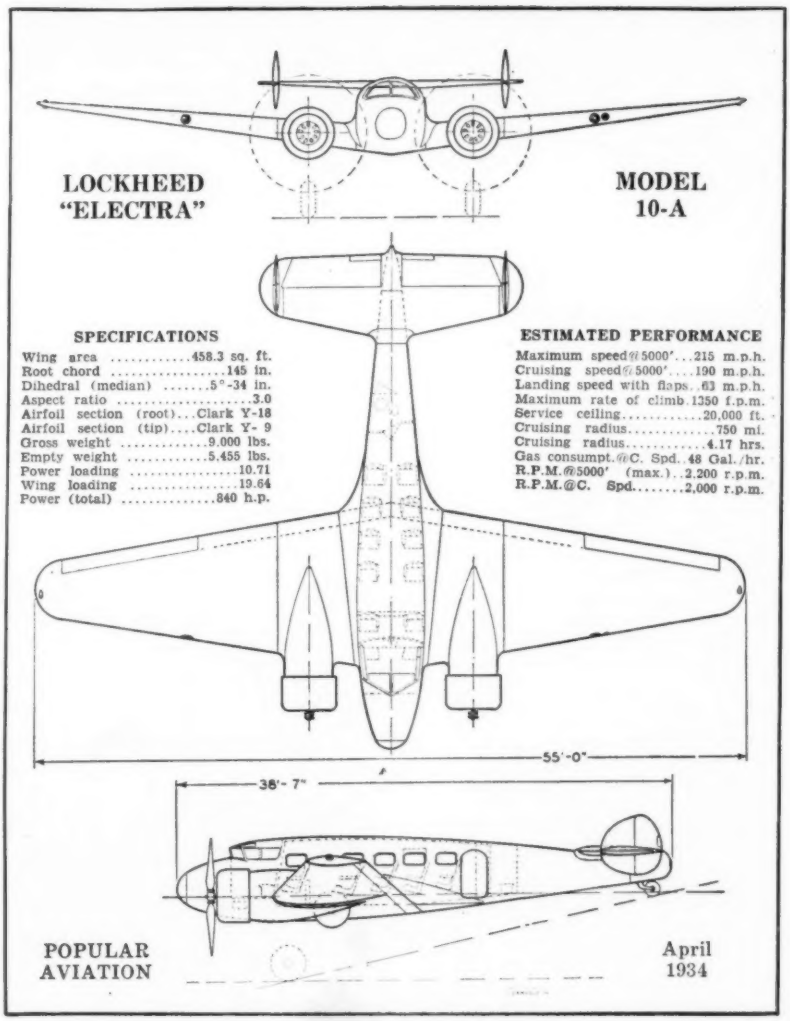
It is designed to cruise at more than 180 m.p.h. with 2,200 pounds of payload, yet its bi-motor power plant is rated only at 840 h.p. The small overall dimensions, clean design and all-metal construction are the answers to the light-weight and economical high speed performance claimed for this ship. It approaches the "flying-wing" type of ship closer than any multi-motored plane.

By the expedient of cutting away the upper surface of the wing at the center, and placing the fuselage in this recess, more than 11 square feet of frontal area were eliminated which, of course, greatly reduces the parasitic resistance. Again, the cabin only projects three feet above the wing.

While very compact, so far as the outside dimensions go, the cabin is full-size for the comfortable accomodation of 12 seats. The cabin, 58 inches wide, 60 inches high and 15 feet long, is completely sound-proofed by Western Electric Engineers and is equipped with an efficient ventilating system combined with thermostatic heat control. Lavatory facilities are provided at the rear of the cabin.

Baggage space totals 68 cubic feet, 40 cubic feet being located in the nose of the ship while the remaining space is arranged in two units of 14 cubic feet each in the two wing stubs. Excellent vision is had from the pilot's cabin which is located well forward and clear of obstructions.

The wing construction is unique, being of the semi-stressed skin type with a single spar built up of structural shapes stamped out of sheet duralumin. The single spar is carried through the fuselage with a minimum of interference in the cabin and it is claimed that this design is both stronger and lighter than the double or multi-spar system. The airfoil section at the roots of the wing is the Clark Y-18 with a Clark



Y-9 at the tips. Detachable wing panels facilitate inspection and maintenance.

Simple but effective wing flaps materially reduce the landing and take-off speeds, the flaps reducing the gliding angle from 14:1 to 8:1. Two fuel tanks with a capacity of 100 gallons each are located in the entering edge of the wing stubs.

This is an all-metal ship throughout, with 24ST used for the structural parts and 24ST Alclad for the skin. All of the electrical wiring is enclosed within a metal conduit system with conveniently located junction boxes.

Two Wasp, Jr., engines develop 420 h.p. each, 2,200 at r.p.m. and at an altitude of 5,000 feet. The compression ratio is 6:1 while the blower ratio is 10:1. They swing Smith Controllable Pitch propellers which are standard equipment.

Another feature contributing to the low resistance of the Electra is the retractable landing gear. The wheels swing directly back into the engine nacelles and are completely faired into the wing while the landing gear is in the retracted position. Normally, the landing gear is electrically operated, but an emergency manual control is also available. The shock absorber is of the Aerol Strut type.

Goodyear airwheels with Goodyear hydraulic disc brakes are standard equipment. The brakes can be applied by a conveniently located lever and are differentially connected to the rudder pedals. This landing gear, together with the use of wing flaps or air-brakes, greatly assists landings with the high-speed plane.

All tail surfaces are of metal, similar to the wing construction, with adjustable flaps at the trailing edges of the rudder and elevator. The areas of the tail group are as follows:

Area vertical fin	15.0 sq. ft.
Area of vertical rudder	16.9 sq. ft.
Area of stabilizer	48.0 sq. ft.
Area of elevators	33.6 sq. ft.

In addition to the Electra being built for the Northwest Airways, this company has options on two additional planes while Pan-American Airways has placed an order for six ships to be powered with Wasp engines.

The loadings and weights, as well as the volume of the passenger and cargo spaces are of interest and are surprisingly effective for such a compact ship.

WEIGHTS

Gross weight	9,000 lbs.
Empty weight	5,455 lbs.
Useful weight	3,545 lbs.
Payload	Variable
Max. gasoline capacity	200 gals.
Gas per hr. @ c. spd.	48 gal./hr.

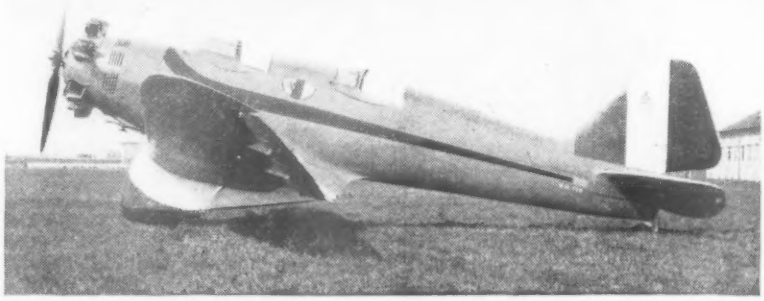
PAY-VOLUMES

Vol. Passenger cabin	300 cu. ft.
Total volume baggage	68 cu. ft.
Total avail. vol.	368 cu. ft.

LOADING

Power loading	10.71
Wing loading	13.64

The Caproni "Sauro-1" Low-Wing Lightplane



A side elevation of the Caproni "Sauro-1" a light sportplane equipped with a Farina T.58, 130 h.p. engine. The top speed is 136 m.p.h.

A LIGHT low-wing monoplane, sport-type, that suggests modern transport practice on a small scale is the "Sauro-1" recently produced by the Caproni Works in Italy.

This is a 2-place job fitted with a Farina T. 58 130 h.p. engine that drives the ship at a top speed of 136 m.p.h. The low-wing is of the full cantilever type, unbraced, which is made possible by the use of a very thick wing section.

The plane is of composite construction, both wood and chrome steel being employed, while the covering is a combination of fabric and plywood. Trimming controls are fitted by which the pilot can adjust the ailerons and elevator to the regime of flight that he desires. These controls are independent of the regular flying controls employed for maneuvering the ship.

SPECIFICATIONS

Wing Span	37 ft. 5 in.
Length	18 ft. 4 in.
Height	7 ft. 2 in.
Weight, empty	1056 Lbs.
Weight, useful	572 Lbs.
Weight, total	1852 Lbs.
Maximum speed	135 m.p.h.
Range	6 hrs.
Ceiling	16,400 Ft.

An American Tandem Propeller System

THE idea of tandem propellers is not new but the application of the tandem principle in a recent American lightplane shows some novel features. This ship will be nameless until such time as the inventor makes his identity known to us.

A single engine is arranged to drive the forward and rear propeller in opposite directions. The advantages to be gained by this arrangement are the elimination of propeller torque and the neutralization of the gyrostatic effect of the revolving propellers. These factors are of some importance in the flying of single-engined lightplanes. This indirectly decreases the drag of wash-in or tail corrections.

Side elevation of an American tandem propeller lightplane of novel design.

Chicago's New Control Tower

by

GAYLE POND

Special correspondent for POPULAR AVIATION.

A group, assembly, huddle or what-have-you in the new control tower. First row, left to right: Clayton Patterson, Marguerite Green and John Becker, Chief Radio Operator. In rear: John Casey, Municipal Airport Manager and Gayle Pond.

"VEBLIN in American Airways Condor 96, five miles south of the airport. Calling WGEH for landing instructions."

"WGEH to Veblin in American Airways 96. WGEH to Veblin in American Airways, number nine six. The wind is 30 to 35. They are landing northwest. All clear, come on in."

"Okay, WGEH."

"OK, Veblin."

The curt, laconic report cut across the chattering turmoil in the little glass-enclosed "Control Tower" on top of the Administration Building at the Municipal Airport in Chicago. Chief radio-operator Becker, keen eyes searching the southern sky, switched a control button and again spoke into the transmitter:

"American Airways 96, four miles south of the Airport. American Airways, trip 19 from New York, four miles south of the Airport."

The announcement broadcast through a public address system, with its two huge amplifiers on either end of the building, can be heard for a distance of two miles and serves as a warning to the entire field to stand-by for the arrival of the transport. Smaller speakers in the waiting room below carry the sound to the waiting passengers and send the "red caps" scurrying to their posts at the gates.

Again, through the crashing static and across the blur of voices on the six receiving sets, came a call from Pilot McMillan in Boeing No. 340 of the United Airlines, ten miles southeast of the airport. The operator reported the ground conditions and warned the pilot of the Condor preceding him.

The gusty wind tore at the windows of the Tower and set the little ball-tipped arms of the anemometer spinning. The needle on the dial in front of the operator swung drunkenly. Watching the gliding Condor, he reported the changing velocities, then as it taxied up to the Terminal he turned to watch the silver Boeing swing into position. He pressed a button that flashed a red signal light to hold a small ship that was ready for a take-off on the end of the runway, then as the Boeing settled to the ground, the red light changed to green. Thus, does this modern traffic-cop control the cross-roads of the air!

Showing the radio apparatus in the control tower with Chief Radio Operator, John Becker, giving instructions to a departing transport ship.

Few people, either casual visitors or passengers at the airport watching the many planes in the air, on the ground, landing and taking off, and hearing the announcements of departures and arrivals with clock-like precision are aware that the pilots are all in close touch with the little glass tower on top of the Administration Building. The regular transport ships, government and mail planes which are equipped with two-way radio apparatus, get their signals direct from the operator while the pilots of non-radio equipped ships watch for the red and green beam of light in the powerful spotlight on top of the Tower.

It is no longer necessary for the pilot in the air, to circle the field to get

his bearings on the direction of the wind on the ground, and then to make a chance-guess on its velocity; nor does he have to stretch and strain his neck in many directions when he is ready for the take-off, to be sure that it's all clear.

Before the Control Tower with its radio and signal lights was established, the only aid to the pilot, either on the ground or in the air, was the much-ignored flagman far out on the runway. If the visibility was poor, it was difficult to see his signals and from his point-of-view on the ground it was not always possible to judge the position of ships flying at greatly varying speeds.

A slow cumbersome ship may be just as much of a menace on the airway as the over-cautious driver on a busy boulevard. Eternal vigilance and precise judgment are increasingly necessary in this fast-growing and complicated business of air transportation.

The necessity for accurate and positive control is self-evident. Over 60,000 landings and take-offs were recorded at the Chicago Municipal Airport during the year of 1933. Six major airlines maintain regular schedules, with approximately 80 transport planes arriving and departing daily—even on the winter schedule! The pilot of each ship is given complete information on the wind velocity and direction both for landings and take-offs, and he is kept informed of all other planes in his vicinity.

One great improvement is the 24 hour service provided by the radio tower. A great many ships, especially during the winter months, arrive and depart after dusk when the visibility is especially tricky. The man who controlls the great flood lights, used to listen for a plane to circle the field, then make a guess at the right moment to switch them on, so as not to blind the pilot; now he is equipped with a small receiving set and by listening to the landing instructions to the pilot, he is able to judge much more accurately when to turn on the light.

As it grows dark, the radio operator switches on the field lights; from the Control Tower the airport presents a *dramatic* sight—runways outlined with the white ground-lights, nearby buildings and hangars, telephone poles and power lines indicated with the red barrier lights, green lights outline the wind indicator and the broad beam of the powerful beacon ceaselessly sweeping the darkened sky. The brilliant flood-light turned on to aid the landing ship has a shaded center, which keeps the pilot from being blinded in its glare, yet throws the runway into sharp relief.

The control tower is a tiny room not more than 10 by 15 feet, and is enclosed in glass, roof as well as sides, so as to give a clear and unobstructed view from all directions. There are six high-frequency receiving sets of the latest design for receiving the signals

(*Concluded on page* 273)

The Aero-Sportswomen

by JOAN THOMAS

MRS. MABEL BRITTON, transport No. 10305 and Governor of the North Central Section for the 99's, took her first flight as a passenger in 1927.

"It was a momentous occasion, for it completely destroyed my peace of mind," she said. "I couldn't rest until I could go up again, which was in 1928, when I took my first flying lesson. In June 1930, I bought a Waco F which has been my dearest possession and greatest joy and I have not made any trip longer than 30 miles by railroad, bus or automobile since the moment I took delivery on my ship. My trips include three Michigan Air Tours, flights into Ohio, Wisconsin, Illinois, Ontario, Arizona and to the West Coast and New York.

"The nicest part of the flying experience is that my doctor husband has taken time out from the practice of medicine to learn to fly too, first to please me, then in wild enthusiasm himself. He now has his license and all our vacations are flying ones, while our free evenings at home are spent poring over maps and enjoying that pastime only secondary to real flight, 'talking flying'."

* * *

Mrs. Franklin D. Roosevelt, always an enthusiastic air traveler according to recent press dispatches, has gone a step farther in making flying popular, by taking her physical examination for a pilot's license. However, she is not taking instruction at present because, "Franklin thinks it would be foolish since we do not have a ship and we can't afford to buy one just now."

When Mrs. Roosevelt was in the city this last fall, we managed to ask her (between the other reporter's breathless questions about where she buys her clothes, why she doesn't wear a hat and what the NRA means to women) why she had come by train instead of air, if the transport accidents last summer had had any effect on her interest in flying, etc. She looked completely amazed and said, most emphatically:

"Oh, *no!* I came on the train this time simply because I had so much work to do that I had to bring my secretary along. You can't imagine how much work we accomplished that one day on the train—no telephones to interrupt, no meetings, no callers (except those who *will* stick their heads in one's stateroom and ask to shake hands). It was a grand opportunity to work and by the time we get back we will have all our correspondence up to date. But I always fly when I travel alone," she added with a smile.

As the flying wife of a flying President, Mrs. Roosevelt is invaluable to the aviation industry. Her frank, friendly interest and the famous Roose-

Mrs. Mabel Britton standing beside her favorite possession, a Waco Model F. Mrs. Britton holds Transport license No. 10305.

velt smile make friends wherever she goes, and her avowed devotion to travel by air, should be worth millions in advertising!

* * *

Half the fun of conducting a column such as this, is the letters one receives. We had often wondered if we had any men readers—and *now* we know that we do! Emma Encinas, Mexico's only woman pilot, writes to say that she has had a lot of fun since our story of her career appeared in POPULAR AVIATION. One American pilot wrote to invite her to fly to Central America with him next summer, another letter brought a proposal of marriage, etc.

Emma conducts a column similar to the Aero Sportswomen in *Anahuac*, an aviation magazine published in Mexico City. She is also a member of the Ninety-Nines and we are sure she would appreciate material on women flyers that anyone can send her. Then, if you want to have some fun, get a copy of the magazine and try to translate it back into English! With a limited amount of French and a few words of Italian at our command we have found it makes an amusing kind of cross-word puzzle.

Little Emilie Betty Folksuh, 16, from Milwaukee, writes "I'm so enthusiastic about flying that it's very hard for me to express my feelings," but she succeeded pretty well in a four page letter. Gladys Kessler of Roanoke, Va., sent a shorter but equally sincere tribute to the column and P. A. The following paragraph out of a letter from Alma Heflin, Spokane, Wash., is typical of a beginner's enthusiasm:

"Where should I write to receive a

(*Concluded on page* 273)

An Amazing Array of Dials

"What a pilot and co-pilot have to look at," in the way of dials, levers, wheels and switches. Here we have the instrument panel of one of the new Douglas Transports in full view.

AN ORDINARY instrument board of a transport plane is complicated enough with its maze of engine indicators, navigational instruments and electrical switches, but when the indicators of a mechanical pilot are added, the board becomes a sort of instrument exhibit.

The accompanying photo shows the instrument board of the new Douglas airliners now in service on the lines of Transcontinental and Western Air. The photograph also shows the indicators of the Sperry Mechanical Pilot which is a distinct feature of these ultra-modern ships, and also the tops of the trimming levers by which the rudders and stabilizers are adjusted for varying load conditions.

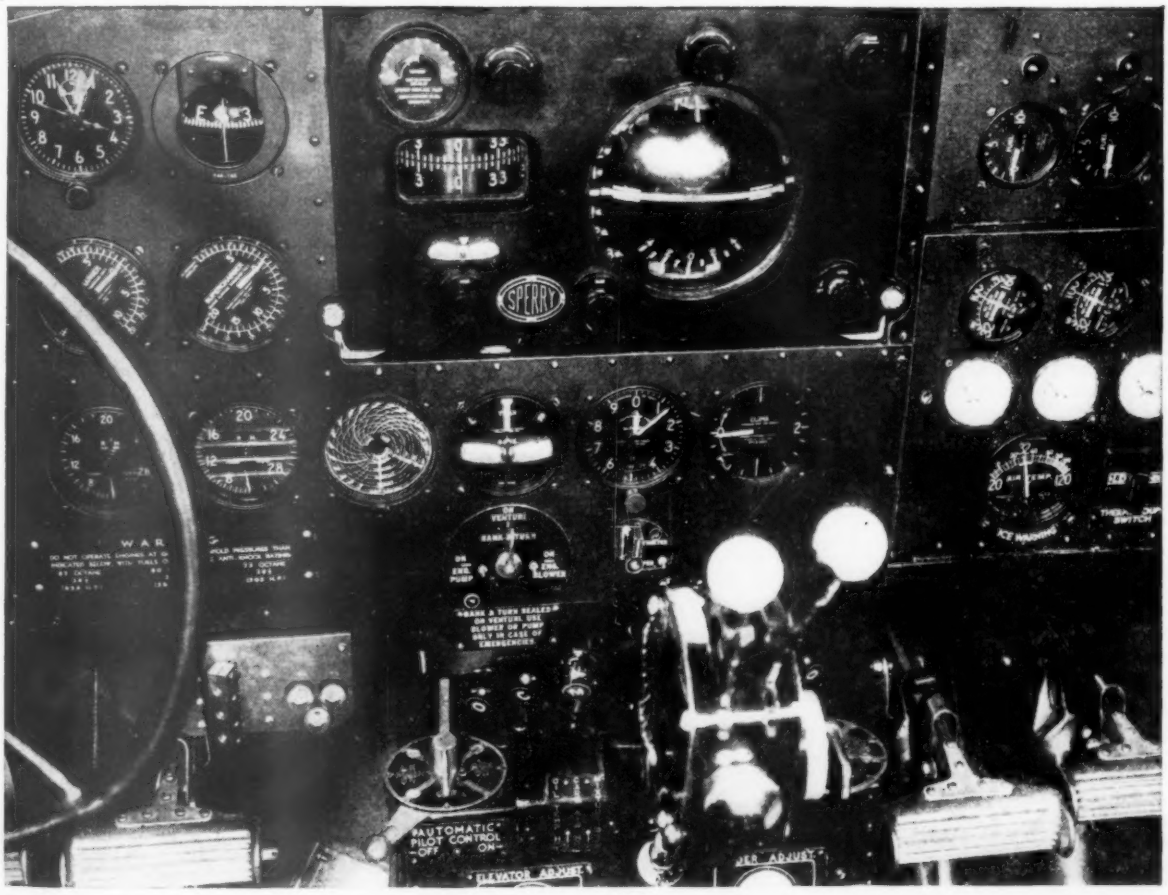
Take-offs and landings are made manually by the pilot in the usual way, but after the ship is once in the air and flying at the proper altitude and in the right direction, the automatic pilot is cut in and from this time on, the automatic pilot holds the ship on a steady course at the desired altitude. This relieves the pilot of physical labor and permits him to spend his time more usefully in the study of maps and weather reports than at the controls. An occasional glance at the instruments is all that is necessary.

The addition of this device increases the total cost of the new equipment on the TWA to $3,500,000, but the company believes that this is money well expended as it adds to the safety of flight and very materially improves the service.

In addition to the Mechanical pilot, which occupies the sub-panel in the center and top of photo, there are the more ordinary instruments relating to the operation of the engines and plane together with the manual controls. The more important instruments requiring frequent reading are at the left and right of the instrument board, directly in front of the pilot and co-pilot respectively.

In the lower right and left-hand corners will be seen the rudder pedals while in the center (bottom) are the trimming adjustments for the elevators and vertical rudder. The adjustments for the wing-flap are also shown.

And so we have determined to make a game, contest or competition for our readers out of the equipment of this instrument board. How many of the above instruments can you identify properly? Send in your list and then compare it with the official list which will be published in an early issue of POPULAR AVIATION. The most complete and most accurate lists sent in by readers will be mentioned in the same issue.



In the center and on a separate panel are the instruments for the Sperry Mechanical Pilot. At the left will be seen the rim of the control column, while along the lower edge of the picture are the rudder pedals. In the bottom center are the elevator and rudder adjustments, etc.

A Study of the Bellanca C-27A

by ERNEST NOBLE

A detailed description of this unique airplane is given below, together with notes and specifications. This ship has a remarkable performance with only a single engine of comparatively low horsepower. See front cover.

PRIMARILY, the Bellanca "Aircruiser," Model C-27A is a heavy-duty all-purpose transport that carries one and one-half tons of payload, either in military or commercial service.

There are fourteen of these planes now in the service of the U. S. Army Air Corps in various capacities and a number are also in commercial service. Used as a military plane, the Bellanca C-27A transport can be arranged in different ways. It can carry 11 passengers, a pilot and supplies, or six patients on litters together with the necessary attendents.

It is not specifically an army ambulance although it is sometimes put into this service. As a hospital ship, the litters are placed in two rows—three litters high. As a passenger transport in commercial service, eight comfortable chairs are arranged in two rows of four seats per row. Two passengers are at the rear of the cabin while one sits beside the pilot.

To reduce the operating cost and increase efficiency, the Aircruiser was designed as a single-engine ship, a Wright "Cyclone" engine, Model 1820-F being installed. This gives a high-speed of 136 m.p.h. and a cruising speed of 115 m.p.h. with a maximum climbing rate of 650 feet per minute.

One of the characteristic features of the Bellanca Aircruiser is the unusual wing arrangement, or rather, the arrangement of the lifting surfaces. Every section facing the air-stream has a definite lifting value, the top wing, the lift struts, the landing gear stubs and even the fuselage contribute to the lift. The peculiar advantage of this arrangement lies in the fact that the lifting surfaces are not confined to one plane but, collectively, embrace a thick stratum of air. This minimizes the "bumping" due to air turbulence and avoids violent pitching.

The Bellanca C-27A transport in the service of the U. S. Army Air Corps where it is used variously as a hospital ship or general purpose ship.

Thus, by use of the characteristic "W" shaped wings, the Aircruiser glides smoothly through turbulent air and in the vicinity of thunderstorms. The inclined lifting struts are really the equivalent of a very deep dihedral angle and so have a very marked effect upon stability.

With the exception of the top wing and tank bays, the structure is all-metal, fabric covered. The fuselage is built of welded chrome-moly steel tubing and only the fuselage sections aft of the cabin are braced with tie-rods. The fuselage is covered with airplane fabric, doped and rubbed to a high finish. The cabin space is ample, the width being 54 inches, the height 6 feet, 3 inches high while the length is 13 feet.

In the 15-place commercial model, the seating arrangement is carefully layed out to insure maximum comfort in short-haul operation. Thirteen passengers are accommodated within the cabin while one sits beside the pilot. At the rear of the cabin is a spacious lavatory with a wash-basin and Dayton sanitary equipment. Air pipes running along both sides of the cabin and beneath the floor distribute the ventilating air throughout the cabin, either warm or cool depending upon requirements. The air is heated by a unit that fits over the exhaust manifold.

The upper wings are of the wood type with wire bracing and a Dural trailing edge. They have two bays, one adjacent to the fuselage contains the gas tanks and connects to the lower stub by two steel interplane struts. This bay is braced with streamline wires, doubled for safety, and a single wire just as an additional safety feature. The outer bay is supported by a tapering lift strut with an airfoil section. Plywood is used wherever steel fittings are attached while the wing spars are routed for lightness and tapered at the ends to form the characteristic Bellanca wing-tip.

Because of careful landing gear design, the Bellanca is very easily taxied on the ground, while the 18 foot wheel tread permits easy ground control in cross-winds. The landing gear equipment can be supplied to meet the requirements of the operator and, in general, is divided into three optional types. Either mechanical or hydraulic brakes can be furnished. With Goodyear Airwheels and the high pressure tires, streamline casings are provided for the wheels, enclosing above two-thirds of the wheels. With the General Streamline Tires, the fairing around the wheel itself is not necessary.

Many safety features have been worked out. In the Bellanca Aircruiser, a pressure fire extinguisher comes as standard equipment with all leads and connections piped to strategic points in the engine compartment. All wiring in the engine compartment is run through protective conduit and double fire-walls are provided.

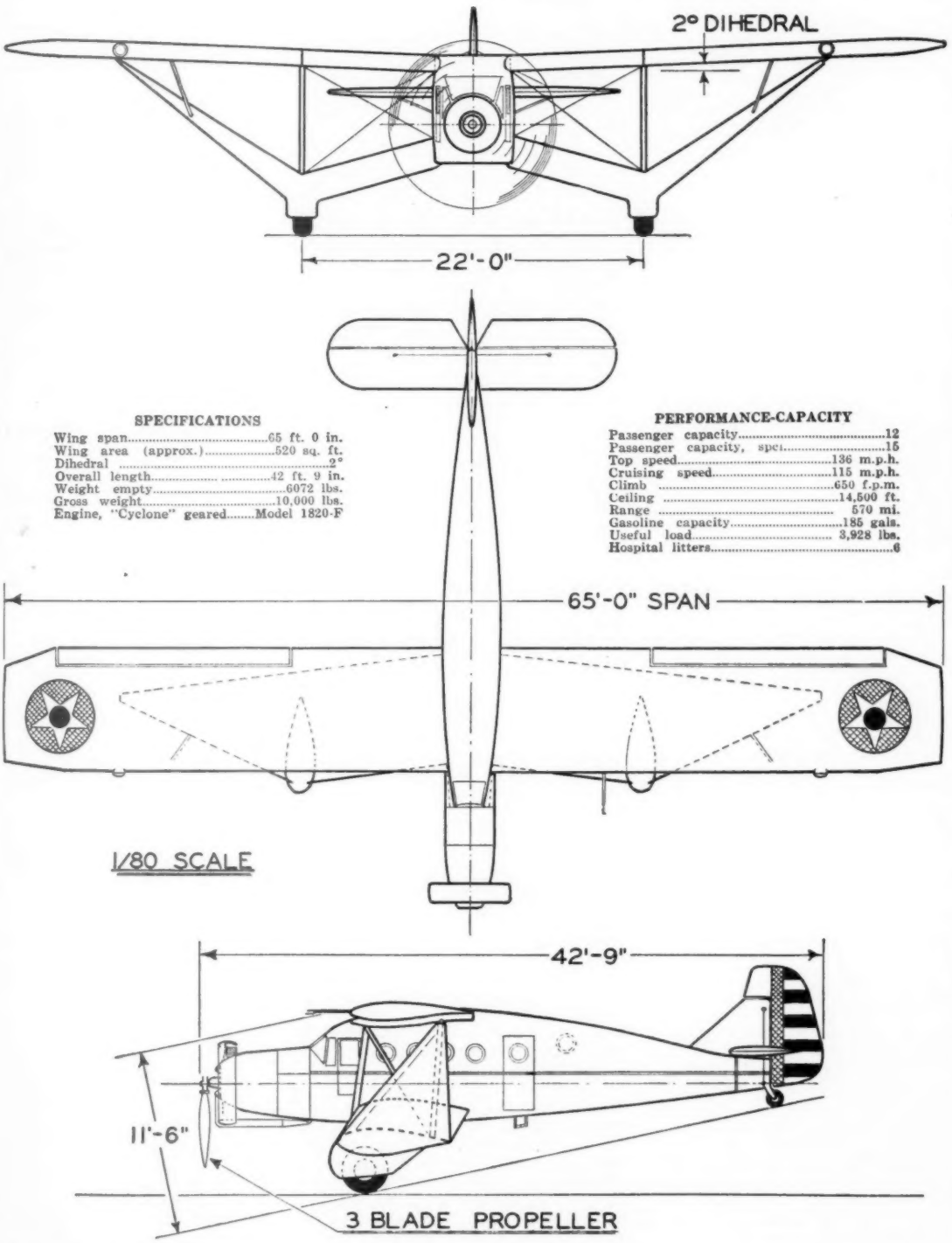
The fact that the fuselage rides high between the two landing gear stubs

(*Concluded on page* 270)

A Bellanca C-27A designed for use as a commercial transport, differing only in detail from the military model above. Note the lift-struts below the wing.

Scale Drawing of Bellanca C-27A

Below will be found the principal dimensions and data relating to the Bellanca C-27A. The standard color scheme will be found on the cover of this issue (April, 1934).



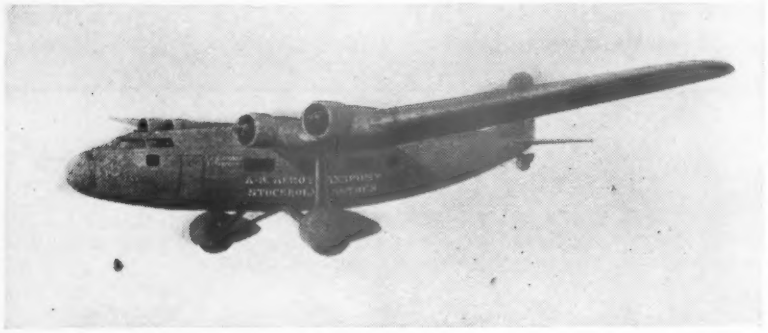
SPECIFICATIONS

Wing span	65 ft. 0 in.
Wing area (approx.)	520 sq. ft.
Dihedral	2°
Overall length	42 ft. 9 in.
Weight empty	6072 lbs.
Gross weight	10,000 lbs.
Engine, "Cyclone" geared	Model 1820-F

PERFORMANCE-CAPACITY

Passenger capacity	12
Passenger capacity, spci	15
Top speed	136 m.p.h.
Cruising speed	115 m.p.h.
Climb	650 f.p.m.
Ceiling	14,500 ft.
Range	570 mi.
Gasoline capacity	185 gals.
Useful load	3,928 lbs.
Hospital litters	6

Fokker F-22 Powered With Four Wasp Engines



The Fokker F-22 as supplied to the A. B. Aerotransport, a Swedish commercial line. This transport is powered with four 525 h.p. Wasp engines installed along the leading edge of the wing.

THIS is an artist's picture of the Fokker F-22 now under construction in Amsterdam, Holland. Powered with four Pratt & Whitney 525 h.p. Wasp T1D1 engines, the Fokker F-22 will carry 22 passengers, a crew of four and baggage and mail amounting to 11,350 pounds useful load giving it a gross weight of 28,100 pounds. The wing span will be about 100 feet and the overall length of the machine about 71 feet.

Mr. Fokker has conceived a novel way of overcoming the cockpit resistance and poor pilot vision (to the side) experienced in most large wide machines with the pilots sitting abreast in a wide fuselage. In the Fokker F-22, the first pilot will sit in the very nose of the plane, with a narrow cockpit cover, located in the center while the second pilot will be slightly behind and to the right. Somewhat lower and to the left will be the radio operator riding backwards. Thus, the three sit in a small triangle facilitating communication and cooperation.

Under the cockpit will be a baggage compartment. Another compartment between the cockpit and the passenger compartment will be partitioned off partly for baggage, partly for a buffet and steward's headquarters and partly for a chart table for navigation. The cabin is to be divided into four compartments, three for six passengers and one for four passengers. Behind the cabin there will be another luggage hold, a wardrobe and a lavatory.

On each side of the cabin, in the wing and behind the rear wing spar there will be another baggage hold accessible from the cabin while a still larger baggage and merchandise compartment, accessible only from the outside, will be located in the wing between the spars. Also in the wing, between the spars, will be fuel tanks with a capacity of 713 U. S. gallons.

With a full load it is calculated that the Fokker F-22 will be able to maintain 9200 feet altitude with any one engine stopped. Both K. L. M., the Royal Dutch Air Lines, and A. B. Aerotransport, the Swedish company, have ordered Wasp powered Fokker F-22's for use on the highly popular Amsterdam-Copenhagen-Malmo service and K. L. M. will also use them on the 900 mile Amsterdam-Batavia service until the 32 passenger Fokker F-36 machines, the first of which is now under experimental development, can be produced in quantity.

The C. W. A. Has Assisted the Airports

MORE than 51,000 men are employed on 476 C. W. A. airport and landing field projects in 41 states, according to the Aeronautics Branch, Department of Commerce. Information on seven states was missing, presumably because applications for assistance have not been submitted or approved.

The reports showed that of the 476 projects, 226 were new landing fields, while 250 were improvements at existing airports. Minnesota led with 63 projects and 6,248 men employed. Florida came second with 43 projects and 4,600 men employed.

The construction and conditioning work is undertaken on municipally-provided ground at cities or towns which either have no landing facilities or have inadequate fields. The purpose of the program is to provide increased employment and at the same time to stimulate private flying. The work is being performed under the direction of State Civil Works administrators as local civil works projects and all requests for assistance are submitted to these officials.

The State Civil Works administrators are advised by aeronautical experts appointed by the Department of Commerce as to the suitability of each site for which assistance is asked. Working under these experts are more than 100 experienced airport engineers.

This large force, in addition to the C. C. C. details which are also clearing space for new airports and landing fields in the forests, should soon clear up the present airway situation.

Smallest Miniature Plane in World

IN A recent display of 'tiny' things, which is a collection of A. Charbneau, was a small plane considered the smallest ever to be made.

It is perfectly formed, made of wood and painted. For a mounting it stands on a grain of rice which looks large in comparison.

The tiny plane is the work of a young Junior College student, David Paschall, Riverside, California. He was about ten hours in fashioning the plane and worked with it under a magnifying glass. It is complete even to the wheels and propeller and the wings are of tissue paper thickness. For wood, he used the thinnest parts of toothpicks and sandpapered them to the desired shapes.

Less than three drops of dope were required, and even this was greatly reduced by thinner to avoid overloading the little craft.

The collector was very happy to add it to his display which has attracted world-wide attention. But—say! Wouldn't you hate to be lost in a plane that size?

The Bisch Trainer

TO PROVIDE a safe way of teaching a student to pilot an airplane, Alvin Bisch, Chicago, has invented and manufactured a new type of trainer that is suspended from steel framework on high towers.

In action, the plane is hoisted and, at the same time, is held securely to the steel structure so that it is impossible to hit anything. The plane has a Model "A" Ford motor with a regular six foot propeller. It carries two persons and includes dual controls and gives realistic action. The riders have the controls, including the throttle.

The Bisch ground trainer in action, freely suspended from the bridge by a cable.

The Opposed Type Engine

by GLENN D. ANGLE

PART I.

A few suggestions on the use and improvement of the opposed multi-cylinder type of engine which has been ignored in recent aviation engine developments. The second installment will appear in the May issue.

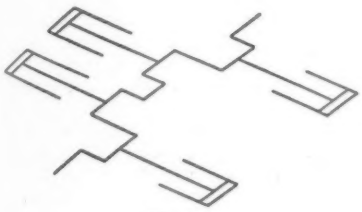


Fig. 1.

ONCE more it appears that the use of the horizontally-opposed type of engine for aircraft is being seriously considered, especially among the designers and manufacturers of airplanes seeking certain installation features which none of the existing engines provide in the fullest measure.

This particular type of power unit has formed a subject for discussion on numerous occasions during the past several years; and yet only in rare instances has this ever resulted in the actual design or construction of such forms, and those few engines which came into existence never progressed much beyond the experimental stages.

Perhaps there are some logical reasons for this situation, even though there does not appear to be any serious objections to such cylinder arrangements from casual observations of the engineering principles involved. At any rate, it seems particularly appropriate that we should now review this timely topic; first, to determine, if possible, just why engine designers have not given units of this form more consideration; secondly, to ascertain why some airplane designers continue to favor engines of this type if they really are inherently inferior by comparison with those in common use.

Now, we shall not devote space to the two-cylinder opposed engine, because its use is not greatly influenced by its inherent characteristics. This type is usually chosen for engines of low output, strictly on the basis of economy. The same is also true to some extent when the four-cylinder horizontally-opposed engine is selected, although in most cases its features may be directly compared with those of a corresponding in-line type.

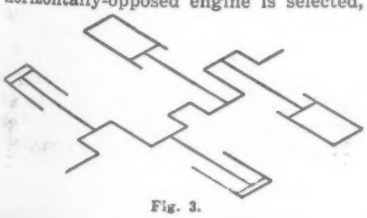
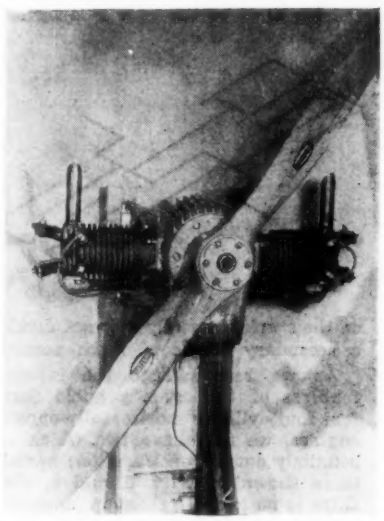


Fig. 3.

However, the essential features for aircraft in eight, ten or twelve-cylinder medium-powered engines of oppositely arranged cylinders may be compared in several ways with the in-line, Vee or radial arrangement of equal output. We therefore shall devote more attention to the latter forms, and thus confine our discussion principally to engine types upon which there appears to be so much difference or uncertainty of opinion.

The horizontal arrangement should be remembered as one of the oldest forms of the internal combustion engine. If we look back far enough, we will find many such engines employed for automobiles. Even for several years after the in-line forms had replaced them in the passenger car field, they continued to be used in quite a number of commercial road vehicles. And now—long after the type was assumed to be practically extinct in the automobile industry—interest has been aroused over the fact that this form of engine permits the utilization of more valuable space than is possible with in-line engine installations in vehicles employed for public transportation.



A small Pickle 2-cylinder opposed type engine, the simplest type of a 2-cylinder four-stroke cycle engine. Plans for building this engine will appear in an early issue.

While it is intended to confine this analysis to engines for aircraft use, it possibly is of interest to know that the type is being revived at the present time in another closely related field. Mr. P. M. Heldt, in an article appearing in the September 17, 1932, issue of *Automotive Industries*, covered the applications to road vehicles in a comprehensive manner.

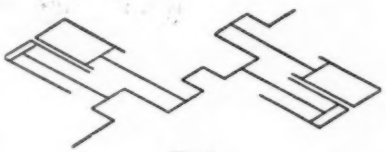


Fig. 2.

Now, should any points which Mr. Heldt brought out in his excellent article about horizontally-opposed engines be repeated here, it will be due entirely to the necessity of regarding these features as they apply in particular to aircraft. Most everyone knows that the adaptability of any type of engine for various kinds of installation depends upon its inherent features, and while all of these are important, we find the degree of importance in each characteristic changing with each different application.

The primary considerations with any cylinder combination and crank arrangement are even firing sequences and balance of the inertia forces created by the reciprocating parts. Regardless of how ideally a combination might appear for aircraft installation from every other point of view, its features rarely overshadow the objection to engine "roughness." It therefore is evident that we first should investigate the layouts which permit smooth engine operation.

In order to condense this phase of the investigation, we will omit the mathematical analysis employed in arriving at these conclusions. The readers who wish to fully comprehend the manner in which these results were obtained, may check the analysis without much difficulty if they care to do so.

There are seven possible arrangements for the cylinders and cranks in

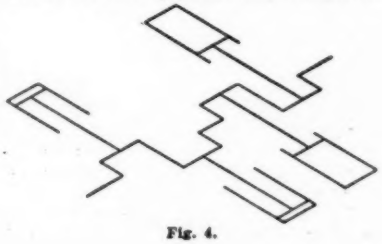


Fig. 4.

a four-cylinder horizontally-opposed engine and we shall outline their leading characteristics by referring to the accompanying diagrams. Fig. 1 shows a conventional four-throw crank with cylinders arranged to effect complete inertia balance. However, from any other viewpoint, this arrangement is unsatisfactory. In the first place, two cylinders of opposite sides must fire simultaneously, thereby producing torque characteristics identical to an engine of two cylinders. The cylinder spacing on each side is not the same, thus preventing the interchangeability of several parts, and besides, the overall length is substantially as great as a corresponding four-in-line engine.

By arranging the cylinders as in Fig. 2, even firing intervals are secured; but due to a pronounced secondary rocking couple, and the cumbersome shape of the engine, this form should not deserve much consideration.

In Fig. 3 we have the same crank arrangement, with even 180-degree firing intervals and the cylinder spacing the same on each side. If desired, the center main journal may be eliminated, and we then would have a three-throw crankshaft, with a central double crank-pin, and two single crank-pins at each end. While the primary harmonics of the inertia forces are completely balanced in this arrangement, there is a horizontal rocking couple due to the fact that the resultant secondary harmonics of each end pair act in opposite directions.

In Figs. 4, 5 and 6, a different crank arrangement is shown. It will be noted that the cylinders are arranged in Fig. 4 the same as in Fig. 1, but in this case even firing is secured. The secondary harmonics cancel completely because the resultant of each pair in phase passes through the center of the engine. However, the resultant primary harmonics do not balance out completely, and to accomplish this counterweights would be required, or else arrange opposite cylinders on the same axis, which obviously would be a difficult thing to do. The awkward form of the engine, however, is sufficient to discourage its selection.

The arrangement shown in Fig. 5 is even less attractive, and it matters little that even firing can be obtained and moreover that the resultant primary harmonics cancel out and only a secondary couple remains.

Again in Fig. 6, we may observe a combination which requires two cylinders to fire simultaneously 360 degrees apart, but in other respects this form would be ideal. The resultant primary and secondary harmonics cancel out,

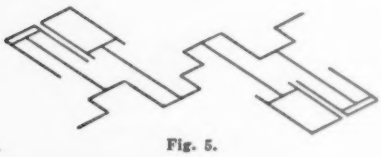


Fig. 5.

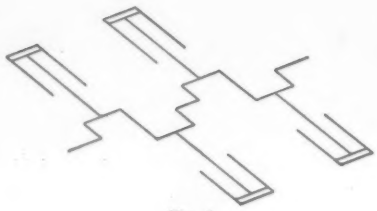


Fig. 6.

and the cylinders are spaced the same on each side.

The two-throw crankshaft shown in Fig. 7 is the only remaining form which enables four cylinders to be arranged diametrically opposite. This arrangement assures even firing intervals, and is often favored because of its compact form. The primary harmonics introduce a rocking couple in the horizontal plane, but this may be cancelled by introducing an opposite couple through the addition of counterweights.

In any case, the couple is not great in magnitude so long as adjacent cylinders are placed close to one another. Now if opposite cylinders are arranged coaxially, no couple is introduced by the secondary harmonics, although the normal offset resulting from placing the big ends of the rods side by side

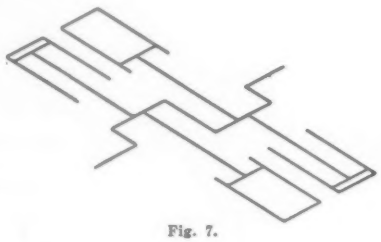


Fig. 7.

on the crank-pin really does not develop a secondary couple of much account.

As we recapitaulate the inherent features of the seven possible forms for four-cylinder horizontally-opposed engines, we first have two which are definitely out of consideration; namely, those shown by Figs. 1 and 6, since there is no logical reason in employing four cylinders and firing each pair simultaneously. Those shown by Figs. 2 and 5 would be rejected by the majority of designers because of their awkward form. This leaves us three arrangements shown by Figs. 3, 4 and 7 from which to make a selection.

Between the first two examples—that employ four crank-throws—the layout of Fig. 4 is better from the standpoint of balance because no secondary couple exists, and the primary couple—when opposite cylinders are not coaxial—can be readily compensated by balance weights. However, the cylinder arrangement is not all that should be desired, so the form shown by Fig. 3 would be the more logical choice.

EDITOR'S NOTE: *The second article in this series will appear in the May issue.*

L.A.A. Becomes the A.A.L.

by LESLIE LONG

WHILE POPULAR AVIATION is not now featuring the old L. A. A., it is only natural that the publishers should be interested in its progress. The Editor has asked me, as chairman of the organization, to comment at various times on its course of action. Before going further, it would be well to state that the name has been changed as previously suggested. It is now the "Amateur Aircraft League." This name is much more convenient and states our purpose quite fully.

The League is here to stay. It has a definite goal and this goal is going to be reached if it is humanly possible. There is not a thinking man in the country who will deny that the present restrictions on amateur flying are not unjust. At present, it seems that we have little hope from the Department of Commerce, in spite of the "New Deal." They appear to have no interest whatever in anything smaller than big business.

The Department is backing the building of numerous city airports, which airports will be of little benefit because there is no one to use them. Among the poorer classes, there are very few airplane enthusiasts who can meet the requirements in force. It takes real money to buy and maintain a ship that meets the approval of the inspectors.

Most of the state laws were passed without proper consideration. Many officials frankly admit they wish they were not in effect. Many do not enforce them in the strict sense of the word. It should not be too difficult to show legislators where they are harming both the amateurs and the flying industry for no good cause, and to induce them to pass new laws allowing more freedom. The airplane has by no means reached perfection and the more experimenting there is done, the more opportunity there is for improvement.

Members are coming now at a better rate than at any time since we started, and it should not be long till we have weight enough to impress any one. This is a serious business, and if we are kept down in the future it will not be due to lack of effort. As a civilized people we are content to live under laws that attempt to guarantee public welfare, but we can not submit to the Czarism that dominates amateur aviation.

Soviet Air Mail

AN AIRPLANE postoffice, operated like a railway mail car, has been placed in service in Soviet, Russia, between Moscow and Kharkov. Letters are sorted in the air, pouched in the plane and then dropped at destination. The Soviet government hopes eventually to extend this service to the farthest reaches of its vast domain.

Practical Lessons in Aviation

by JOHN B. RATHBUN

Here we take up the elementary theory of lifting surfaces, how the force of an air stream is converted into a vertical lifting force by an inclined plane and how the air flow is diverted.

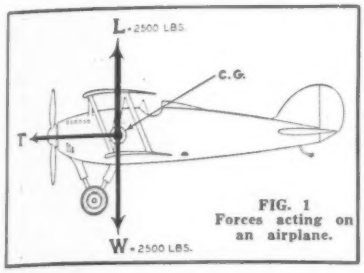


FIG. 1
Forces acting on an airplane.

BEFORE we start on the complex subject of airplane wings, and the underlying theory of their lifting effect in flight, it will be necessary to first enter into a short preliminary explanation of the forces, accelerations and velocities involved.

To begin with, the flight of an airplane, or any other heavier-than-air machine, depends upon acceleration. The weight of the airplane and its load, for example, depends upon the "acceleration of gravity." The lifting effect of the wings is due to the fact that the wings accelerate large masses of air downwards—opposed to the acceleration of gravity. That is the story in a nutshell.

Acceleration is the rate at which the speed or velocity of an object is increased and it is always involved with a force. For example, if we start a body into motion by pushing on it, the increased velocity is the acceleration while the force that we apply to the body is the result of this acceleration. The quicker we get the body into motion, the greater will be its acceleration and the greater will be the push or force required.

It makes no difference how we change the rate of motion or acceleration, the act is always accompanied by a proportional force. This force is most in evidence when we start a body into motion from its position of rest, or when we increase the velocity of a body already in motion. This force is created when we increase the velocity along a straight line or when we attempt to change the path of motion.

To change the direction of motion means that we are accelerating the body into another direction, hence the development of centrifugal force when the body is moving in a circular path.

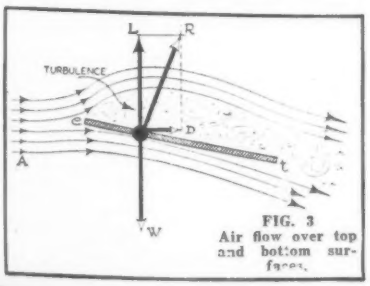


FIG. 3
Air flow over top and bottom surfaces.

As bodies normally tend to move along a straight line, it is evident that a continual force must be applied to accelerate the body toward the center of a circular path, hence we have centrifugal and centripetal forces exerted when the object moves in a circular path or curved path of other form.

Now, the weight of an airplane and its load is a downward force due to the attraction of the earth's gravity. This force is expressed in terms of pounds, ounces, grams or kilograms, and like other forces, is due to an acceleration produced by the earth, which in this latitude, causes an acceleration of 32.18 feet per second. Thus, a body freely falling in a vacuum, will increase its velocity 32.18 feet for each second that it falls.

The acceleration due to gravity, symbolized by the letter "g" in textbooks, varies somewhat at different points on the earth's surface. It is least at the poles and greatest at the equator and, strange to say, any given body weighs more at the equator than it does at the North or South Poles.

Let us look at Fig. 1 where we see an airplane in flight with the principal forces acting on it indicated by arrow lines. The downward acceleration of gravity produces the force (W), or a weight of 2,500 pounds. If this force is not counteracted in some way, the airplane will drop in the direction of the arrow with a constantly increasing speed. The acceleration in this case will be considerably less than g=32.18 because of the air resistance on the wings and fuselage.

Now, it is obvious that an upward force (L), equal and opposite to the weight (W), must be applied to prevent the descent of the plane. It must be applied to the center of gravity (C. G.) just as the weight (W) ends at the (C. G.) if the plane is to remain in a horizontal position without overturning. Under such conditions the plane is said to be in "equilibrium" or balanced. For forward motion we require the third horizontal force (T) which is provided by the propeller, but at present this is not involved.

There are several ways in which we can create the opposite and equal lifting force (L) that opposes gravity, but in nearly every case of a heavier-than-air machine, this requires the downward acceleration of masses of air, so produced that the force due to the accelerated air creates the upward force (L).

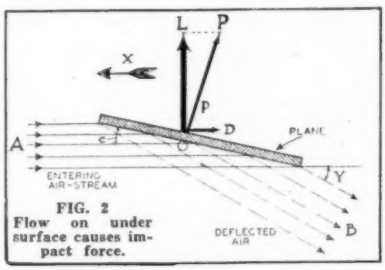


FIG. 2
Flow on under surface causes impact force.

In the case of the airplane, the wings deflect the airstream downward, producing a lift. In the case of the Autogiro or helicopter, the rotating blades of the horizontal propeller accelerates the air downward. To climb we must provide the force (L) with an additional force required for overcoming the air resistance. So far, with the plane in equilibrium, and without considering the mechanism of the wing, the propulsive force (T) is not now considered but will enter later into the scheme of things.

For the sake of simplicity, for the time being, we will consider a perfectly flat plate or plane travelling through still air in the direction of the arrow (X) in Fig. 2. Again, for simplicity, we will consider only that portion of the air which strikes the bottom of the plane and for the time disregard the reactions taking place on the top surface.

At (A) is the original undisturbed air in front of the plane, the plane moving toward the left as indicated by the arrow (A). The air (A) is struck by the plane and is deflected downwards along the dotted lines (B), which is equivalent to an acceleration in a downward direction. The impact of the air-stream now produces the normal pressure (P) on the bottom of the plate which can be resolved into the vertical lift force (L).

The pressure (P) is "normal" to the plate, or at right angles to it, and thus acts in the direction (OP). This is then converted into terms of the

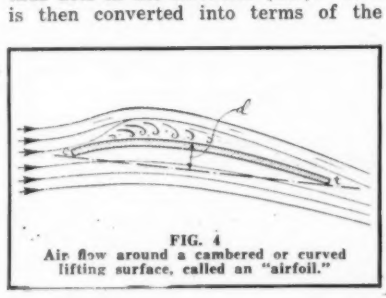


FIG. 4
Air flow around a cambered or curved lifting surface, called an "airfoil."

vertical lift (L), the lift being obviously less than the total pressure (P). The downward acceleration rate is shown by the angle (Y).

At the same time that the pressure and lift are produced, a horizontal "drag" force (D) is also created which acts in the opposite direction to the motion of the plane. This drag tends to stop the motion of the plane through the air and it is this "drag" or resistance that must be overcome by the engine and propeller of the airplane.

The amount of the drag depends upon the sectional form of the plane, the angle of attack (C) and the total load carried. When the angle of attack (C) is increased, the values of (P), (L) and (D) are also increased within certain limiting angles. But, when a certain angle is exceeded above the "critical angle," or the "burble point," the lift falls off quickly and the plane then drops or "stalls."

Just at this point I wish to call your attention to the fact that the motion of the plane and the air are purely relative in producing lift, drag and pressure. It makes no difference whether the plane is moving toward the left in the direction of arrow (X) or whether the plane is standing still with the air moving to the right as indicated by the arrows (A).

Now, the total air deflected downward is the measure of the lift. No matter what the form of the wing may be, plane or cambered, or what the intimate reactions of the air-stream may be around the wing itself, it is the final deflected direction and acceleration of the air column that produces the lift.

Getting down to figures, we have a physical law that states, "force is equal to the mass (m) multiplied by the acceleration (a)." The mass, which is a quantity difficult to explain, is equal to the weight (W) in pounds divided by the acceleration of gravity (g), so that the force or lift created can be expressed by:

(1) $F = am$, or (2) $F = \frac{a \times W}{g}$, or for our latitude, (3) $F = \frac{a \times W}{32.18}$

In the above equations, the force (F) and the weight (W) are in pounds while the acceleration (a) is in "feet-per-second-per-second." Now, just to show what a tremendous weight of air must be deflected by the wings, let us try a problem in which a 2,500 pound airplane is supported by air which is being accelerated downwards at 50 feet per-second-per-second. Thus, to gain the lifting force (L) of 2,500 pounds we must transpose the above equation (3) to obtain the weight (W) of the air required in pounds.

(4) $32.18 \times L = a \times W$, then, (5) $W = \frac{32.18 \times L}{a}$

By substituting the given values of acceleration equal to 50 feet-per-second-per-second and the weight of the airplane (L) equal to 2,500 pounds, we have:

(6) $L = \frac{32.18 \times 2{,}500}{50} = 1{,}609$ pounds of air per second.

Thus, to support 2,500 pounds in flight, regardless of the type of wing, requires that we deflect 1,609 pounds of air downwards every second. This is about four-fifths of a ton per second or 48 tons of air per minute at the speed given. If the acceleration is more rapid, then less air will be required and vice-versa.

All of the forces shown intersect at a common point (O) which is called the "center of pressure." It is at this point that all of the pressure can be considered as concentrated. If pivoted at (O), the plane would balance for this particular angle of attack. However, the position of the center of pressure (C. P.) varies with the angle of attack (c), moving backward when the angle is increased. Therefore, the plane will balance only at one point for each angle of attack.

In Fig. 3, we show the flow over both the top and bottom surfaces just as the flow takes place in actual practice. The air flow beneath the plane is essentially the same as in the first diagram, except that the portion (A) of the air-stream now rises to meet the plane because of compression. The forward motion of the plane materially increases the pressure in advance of the leading edge (e).

An early Wright biplane showing the struts running to the front spar that also forms the leading edge of the wing. The wing is double surfaced.

But the character of the flow over the top surface is entirely different from that at the under surface. The upper stream does not cling close to the upper surface, but rises high above it in the form of an arch. Between this arched upper stream and the plane is a low pressure zone filled with power consuming air eddies, whorls and disturbances known as "turbulence." A great percentage of the power of the engine is uselessly expended in creating this turbulence which alone makes the use of a flat wing or plane impracticable.

But, the total lift—strange as it may seem—is increased by the reduced pressure or partial vacuum in the turbulent zone, therefore, the lift of the plane is greater than can be explained by the impact theory or the "Newtonian Theory" advanced by early scientists. The reduced pressure above the upper surface obviously increases the lift since the total effective pressure and lift are due to the difference of pressure above and below the plane. The less the pressure on the top surface, the greater will be the pressure difference and the greater the lift.

The forces now acting on the plane, neglecting the pressure, are the lift (L), the drag (D) and the resultant

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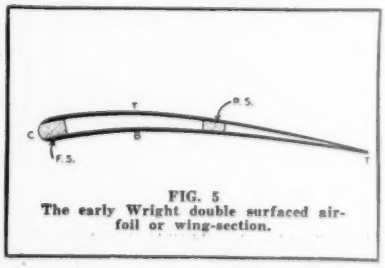


FIG. 5
The early Wright double surfaced airfoil or wing-section.

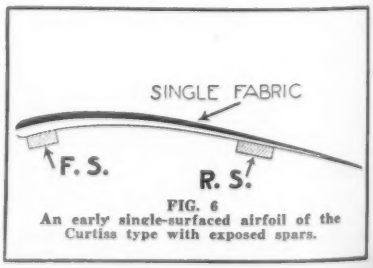


FIG. 6
An early single-surfaced airfoil of the Curtiss type with exposed spars.

Bring the Airport Into Town

by KEITH J. FANSHIER

A plea for the centralization of airports within large cities by a frequent user of the airlines. Mr. Fanshier also points out a means by which this most desirable improvement can be made.

DO THE Big Shots in commercial aviation fully realize the fact that, under some circumstances, it requires a longer time for the business man to reach the airport than is required for the flight to the city of his destination—to say nothing of the further delay in reaching his objective from the second airport?

This, it appeals to the writer, is a sad story.

It is a strange contrast, in which the "industry of flight," built upon the very element of speed and the annihilation of distance, permits the physical business of reaching airports hang like a mill-stone 'round its neck.

Why should it require as long in preliminary and subsequent ground travel to and from airports on the Chicago-St. Louis trip, for instance, as it takes in flight between the two cities? It does—frequently. Hold a watch on it sometime.

Virtually all economists of note seem fairly well agreed that we are witnessing the beginning of a movement away from the super-crowded conditions of the great cities. In this movement, it is held, closely-grouped business and industrial areas of cities will give way to more scattered types of urban communities.

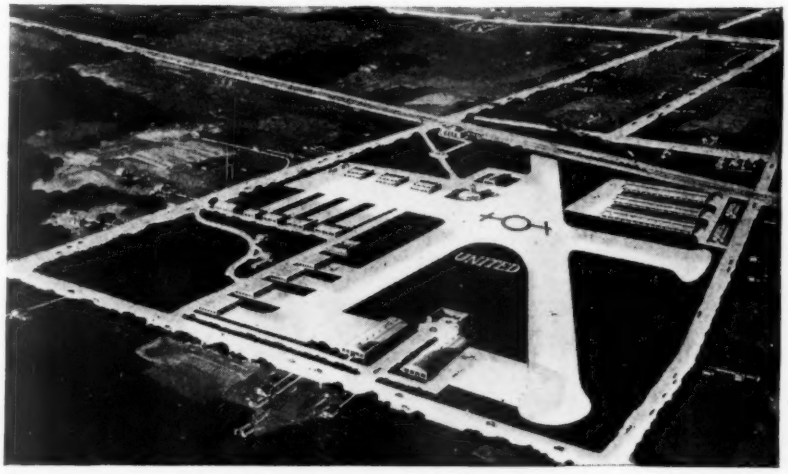
The decade of the Nineteen Thirties may well go down in history, according to all present indications, as the decade of clearing out and leveling thousands upon thousands of acres of old, unfit and actually dangerous buildings in the business areas of our cities. Great sections of cities, previously considered to be likely sites for large buildings as far ahead as the mind of man could conceive, have already disappeared under the pick-axes and crowbars of wrecking crews.

But what has this to do with aviation?

Well, it has this to do with it. Put it another way and let's see if it hasn't something important to do with it. Under the present trend of building conditions, literally hundreds of cities now have the possibilities, for the first time, of re-locating their airports; and at a minor or at least a very moderate cost, of placing them at central convenient and vital spots in the very heart of the communities.

And now, as slang has it, "So what?"

Well, possibly, "So nothing." At least probably nothing for a long period of time until thousands of city dads on hundreds of municipal council boards, as well as aviation authorities, awaken too late to the fact that their respective cities need centrally located airport facilities after the available sites have been ceded over to other uses on long-term accommodations.



Most large airports are located in the open country, like this field, miles away from the center of the city. This is typical—no better nor no worse than the rest of the commercial ports.

Aviation has numerous handicaps today, but none more destructive and more devastating than the vicious handicap of poorly-located ports.

Sometimes, the view of the outsider is more valuable in these things than the view of the "insider." The aviation industry should come to a realization that what governs in this case is not what the airline operators may think about their port provisions and locations being ample and adequate and suitable. What governs in this case is what the user and the flying public thinks about it.

The aviation industry also should realize that these poor locations—yes, they actually are poor—is costing it precious money and precious time; money in actual loss of business, traffic and revenue. It is delaying its development by retarding the increase in use of planes by the public. Is anyone so bold as to say that aviation does not need all the good-will and friendship and "rooters" it can get? Just think that one over.

Recently, the writer had occasion to travel from Chicago to St. Louis and return—250 some-odd miles by rail, substantially less by air. The writer travels almost exclusively by air and, if he may say so, has a good many flight hours to his credit—if that means anything. Accordingly, the trip was made, to and return, by air.

It is a distance of some fifteen miles from the center of the Chicago business district to the Chicago municipal airport at Cicero and Sixty-third Street,—*not* as the crow flies, but as the taxicab crawls, jogs or sways. The procedure on this day, with stops at various hotels for passengers, stops for red lights, stops for other traffic and stops, stops, stops for whatever cause, was such that one hour and fifteen minutes was required in reaching the airport. The flight, a beautiful one, put us down at the St. Louis port in something less than two hours.

On the return, aided by a strong tail-wind, in a low-wing five-place ship, behind a motor which was a personification of power itself, the trip was a magnificent performance requiring only slightly more than one hour. Then again, the wearisome taxicab journey which delivered other passengers to downtown hotels in anything from one hour to one hour and ten minutes and the writer to the Chicago and Northwestern Terminal where he wished to be dropped, is ten minutes more.

In other words, under unfavorable flying conditions, a trip of some distance required only slightly more time than the nuisance of a drag to the airport. With favorable flying conditions, the air portion of the journey required only about the same amount of time as the trip from the airport downtown. And this, figuring the cab trip on only one end of the journey!

These are not exaggerations. How long can this condition, and others like it, continue if the airline operators wish to generate public good will? You may say on the longer flights the proportion of the cab-time to flight-time is much cut down. Yes, but the actual cab-time is not cut down, and did you ever consider the feelings of the pass-

enger who had spent eight, ten, or more hours, in air when he is forced to be subjected to the experience of another hour, at an average speed one-tenth that he has just left, under harrowing traffic conditions?

Every passenger in the jolting, crowded, swaying, skidding cab said he felt much safer in the air than in that taxi. Indeed, they all probably were safer.

One passenger was a college professor of psychology. He contributed a new angle to the question:

"Flying is wonderful—a glorious sensation to the beginner and I am sure that it must retain something of a thrill even to the veteran. But this !!!!!, grinding ride [yes, he said it] after the flight is bad business. It's bad for flying because it's bad for the traveler because, in turn, it is a definite anti-climax. It puts a bad taste in the mouth, figuratively speaking. It removes the edge from the experience and lets him down. It is psychologically wrong and is criminally revolting."

With vast tracts being laid vacant in the hearts of our cities and with men demanding work, the re-location of airports in central sites takes on new aspects. Doubtless there is scarcely a single great city where close-in location of airports could not be managed somehow, without working too severe hardships on any of those involved.

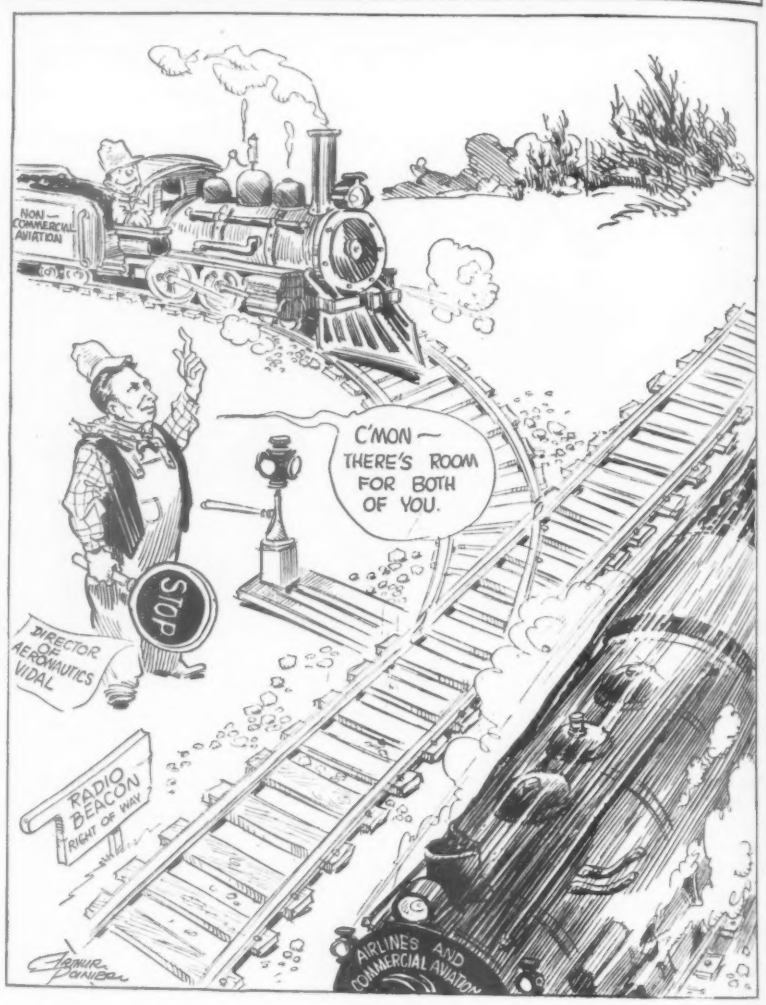
In the case of Chicago, the city has a great natural airport site at the water's edge in Grant Park, on Lake Michigan, with facilities for easy access of land and water planes. A moderate expenditure of money, it has been figured on the basis of complete engineering surveys, would be required.

It surely is not too much to say that air travel could be increased tremendously if airports could be re-located. Certainly, in the case of Chicago and numerous other cities in the country this is true. The writer has made it a point to question all possible contacts on this subject. With the exception of those whose habits and business necessities make it absolutely required that they use the air exclusively, the answers have been almost 100 per cent to the effect that they would use it more if it were made physically easier and quicker to reach ports.

Consider this unusual circumstance: Aviation is young. It certainly is a new industry, if there ever was one. You might say that it's in its swaddling clothes. Yet this phase of the accommodations which it offers to the public and apparently thinks nothing of it, is antiquated and out-dated as badly as some of the impossible facilities of the railroads—the state of the railroad facilities having been partially responsible for aviation's progress thus far.

Aviation junks its out-moded and obsolete flying equipment. Here is something which is holding it back and handicapping its growth and acceptance and good will—and performance.

All Pilots Can Ride the Radio Beacons



WHEN J. Abelson, Denver, Colo., sent in a complaint concerning his difficulties with an airline "supe," he certainly started something—and we are glad that he did. His letter, published in the January issue of P. A., caught the attention of the Department of Commerce, and the Department, through Frederick R. Neely, Chief, Aeronautic Information Section, promptly took up the matter with us.

The following is the interesting and valuable letter received from Mr. Neely which we present for the information and protection of other readers.

"We have just read in the January issue of POPULAR AVIATION a letter signed by J. Abelson, Denver, Colorado, in which he states he 'got bawled out good and plenty on the . . . Airways by one of their officials.'

"We are at a loss to understand how this could have come about and if the official was a representative of the Department of Commerce we are anxious to find out who he is. If it was an airline official, we would also be interested in learning his name. In the belief that you have a more detailed address for Mr. Abelson, which would preclude any delay in a letter reaching him, I would thank you to let us have it, if it is available. We want to get in touch with him and get the details of the matter about which he has written you.

"On the face of his complaint, we would say that the reported action against him is absolutely unjustified, as the radio beacons and other aids to air navigation provided on the airways by the Department of Commerce are for the use of all that fly.

"Appreciating any assistance you can give us to enable us to get in touch with Mr. Abelson at the earliest possible moment and hoping that you will communicate with us in the future if similar matters are brought to your attention, I remain

"Sincerely yours,

"Frederick R. Neely,

"Chief, Aeronautic Information Section."

Thank you Mr. Neely: This sort of letter helps a lot.

Farewell to Our Liberties

by COLIN K. CAMERON

No, this does not refer to personal liberties, such as were rudely interrupted by prohibition, but an entirely different kind of liberty. Read and find out.

LIBERTY is dead! Or it will be dead in the near future, if one can depend upon the reliability of War Department orders that have recently directed the demise. And War Department orders, be it known, usually mean just what they say.

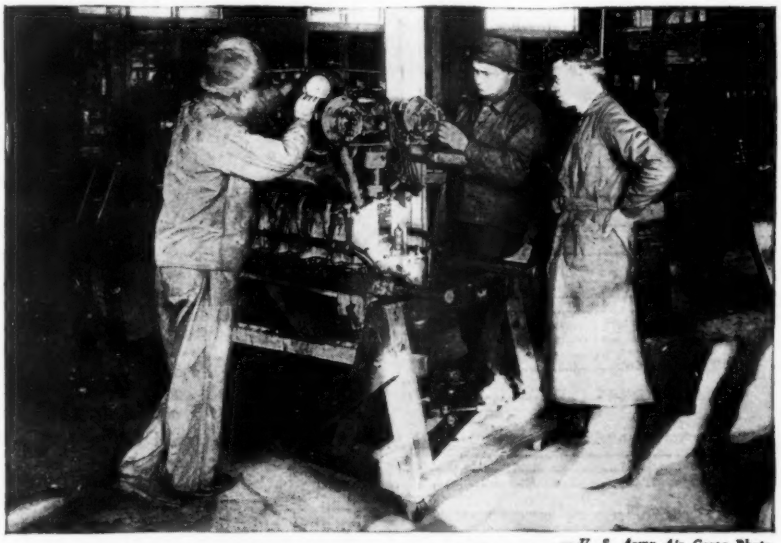
The death of Liberty is going to bring to many a pilot a little tinge of regret—a lump in the throat and possibly a tear. For this particular Liberty means a great deal to most birdmen. In fact there's hardly a flyer in the Army or the Navy who doesn't owe a great deal of his training to Liberty! And there isn't a single cloud-hopper who has shoved one of the old DeHavilands through the skies who doesn't know Liberty well. For she took him there—and most always brought him back.

Perhaps we'd better state that the Liberty to which we are referring isn't the brand for which our forefathers died and which old Patrick Henry preferred to death. This particular Liberty is the one that caused all the world to open its eyes in wonderment when it was born in the early days of the World War—the Liberty airplane engine.

We all know of those ninety-day wonders that went into the Grand Scrap—those grocery clerks and stock-brokers' clerks and bookkeepers who were yanked from their counters and cages and desks, jammed into ill-fitting uniforms and leather leggings, jerked through three months of training camp and then commissioned as officers in the Army of the United States. We all know them—and know also how valuable most of them were during those difficult days of the War.

Few of us know of the hurry-up commissioning of the Liberty engine, however. Few of us know that this engine, often described as one of the greatest American mechanical and engineering accomplishments of the War, was designed in just five days! A five-day wonder; instead of ninety days!

When the United States signed up for the big fight on that fateful day of April 6, 1917, the American air service was practically *ain't*. A single squadron—and even that single squadron was serving as one of the spare parts in the Signal Corps. This lone outfit, with its worn-out damaged and obsolete equipment had just dragged itself back from Pershing's punitive Paseo into Mexico, and was even then squatting down in a heap somewhere around El Paso, trying to lick its wounds into healing.



—*U. S. Army Air Corps Photo.*

The old Liberty 400 undergoing a few readjustments and repairs.

Then the country awakened to the fact that Icarus was to play a great part in this new type of war—a war that promised to be something of a change from the business of chasing bow-and-arrow armed Indians around the plains and half-starved Mexicans about the Rio Grande. So Uncle Sam took stock of his flying force—and was pretty much disgusted with it. Not that the birdmen of the time weren't darn good men. They were every bit as good as the ones we have today—but they had no equipment and wouldn't have known what to have done with it if they had had it.

Anyway, Uncle Sam knew he needed better motors than those he had, and he knew that he needed better ships to put them into. This new war was going to be short, but serious while it lasted.

So the Aircraft Production Board went to work with its list of airplane engine designers. Carefully checking the names, the Board came to that of one E. J. Hall.

"Huh!" said the Board. "This is the chap who designed most of those Hall-Scott engines—the sixes and twelves. He's the chap we need to work on a new motor for us."

The Board looked a little farther down the list.

"Say! Here's another find!" after awhile. "This chap J. G. Vincent. Isn't he the man who worked out that big engine job for the Packard Motor Company?"

Vincent *was* the Packard man. So, when a number of internal combustion experts were invited by the Board to come to Washington, it developed that Hall and Vincent cooped themselves up in a little room in a Washington hotel. There they started work on May 31, 1917.

Five days later they handed in to the Board a set of plans that embodied improvements and modifications of the best features of the most successful airplane engines then known. Five days! To work out and successfully plan the engine that is still looked upon as one of the most remarkable developments made during the war.

These plans were the plans of the Liberty engine. Twenty-three days later, the first finished Liberty was turned out of the shops. It came up to every expectation of the designers and made the Production Board feel as though the war had already been won. Within five months it was being turned out in quantity, and when the Armistice was signed in November, 1918, it was being produced by the thousand.

The new motor proved to be the lightest per horsepower made up to that time. With a total engine weight of 825 pounds, the twelve cylinder job could develop 450 h.p.—or a weight per horsepower of less than two pounds. Not much to brag about now, you'll say. But this was sixteen years ago, when aviation engineering was in its infancy in every part of the world.

(*Concluded on page* 264)

1,324 Aircraft Built in 1933

A TOTAL of 1,324 airplanes was manufactured in the United States during 1933, of which 677 were for domestic civil use, 331 for military delivery and 316 for export. These figures were announced by the Aeronautics Branch, the Department of Commerce.

In 1932, the number of airplanes produced was 1,396, of which 667 were for domestic civil use, 500 for military delivery, and 229 for export. Among the 667 airplanes manufactured for civil use were 481 monoplanes, 165 biplanes, and 21 autogiros.

AIRCRAFT PRODUCTION FOR 1933

MONOPLANES:	
Open cockpit (landplanes)	
1-place	60
2-place	135
3 to 4-place	46
Amphibians, flying boats and sesquiplanes	5
Total, open	246
Cabin (landplanes)	
1 to 3-place	81
4 to 7-place	109
8-place and over	67
Amphibians	3
Total, cabin	260
Total, MONOPLANES	506
BIPLANES:	
Open cockpit (landplanes)	
1-place	11
2-place	18
3-place and over	22
Total, open	51
Cabin	
2 to 4-place	84
8-place and over	25
Amphibians	4
Total, cabin	113
Total, BIPLANES	164
AUTOGIROS	7
Total Civil Aircraft	677
MILITARY AIRPLANE DELIVERIES	331
AIRPLANES EXPORTED	316
Grand total	1324

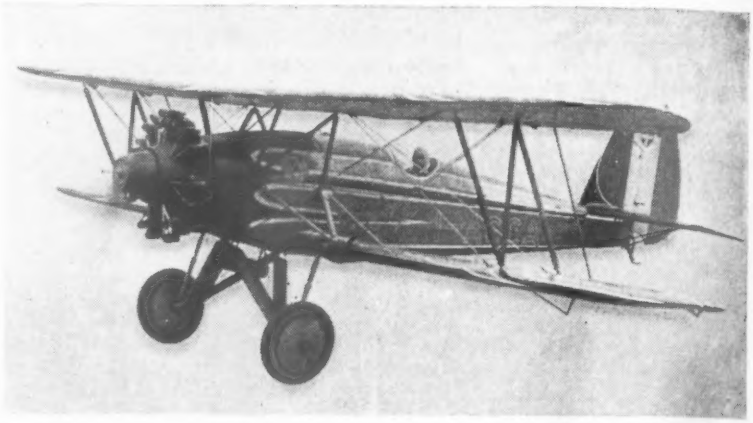
Florida is Building New Airports

THE enthusiastic reception of the technical advice and engineering services offered by the Aviation Division of the State Road Department, on the part of numerous Municipalities throughout the state, is evidenced by the fact that fifteen towns have materially improved the facilities of their airports, fourteen new airports are under construction, and over fifty sites for proposed new airports have been located for which leases or deeds are being secured and upon which actual construction work will be started immediately, unless Emergency Relief labor is curtailed.

In addition to the above, Florida now has 74 land-plane airports, 4 of which are military, 5 rated seaplane bases and 3 dirigible bases. Three of the sea bases with docking facilities are located in Miami, the Viking, Pan American and Curtiss Wright; one is at Palm Beach, the Currie and the fifth at Pensacola, the Naval Air Station. The three dirigible bases are in Pensacola, St. Petersburg and Miami.

QUESTION AND ANSWER DEPARTMENT

All questions of general interest on any phase of aviation will be answered authoritatively by POPULAR AVIATION'S Technical Staff.



The special Caproni acrobatic plane flown by the Italian stunt pilot, Falconi, on his exhibition tour last summer. It was on this plane that he broke the upside down record.

QUESTION:—James J. Keller, Crown Point, Ind. *Could coal be used successfully as a fuel for an airplane?*

Answer:—IT could be used with a steam plant but it would not be desirable for many reasons. First, a pound of the best coal contains only 14,500 B. t. u while a pound of gasoline contains approximately 21,000 B. t. u. The coal would therefore be too heavy. Second, there would be difficulty in feeding the coal into the exceedingly small boiler furnaces employed with airplane steam power plants, the difficulty with the ashes and similar trouble. However, the coal would be safer for there would be a less tendency toward fires.

* * *

QUESTION:—Anton Cusack, Cicero, Ill. (1) *Is there any reason why the old wood construction for airplanes is not as good as steel tube construction?* (2) *Is wood construction lighter than steel tube?*

Answer:—WOOD construction has many points in its favor and you will note that wood wing construction is still used to a large extent even today. It is said that steel construction is fireproof and wood is dangerous, but an examination of a steel tube crackup shows that this is not true. Wood is more rigid, pound for pound, than steel, and this has much to do with the greater stability and lightness of the wood structure. A well built wood plane is lighter for a given strength than the common steel tube construction.

* * *

QUESTION:—Fred C. Kellner, Ottawa, Ill. *What are Flettner controls? How are they applied and what do they do?*

Answer:—IN the Flettner system of control, a small adjustable flap is applied to the trailing edge of the rudder or elevator, the pilot's control being connected up only to the small trailing edge flap. The principal purpose is to reduce the effort required for moving very large control surfaces, for the air-stream pressure on the flaps serves to move the main elevator or rudder surfaces directly.

* * *

QUESTION:—Alfred D. Fortsner, Springfield, Mass. *Why are an uneven number of cylinders used on a radial air-cooled engine? Is this absolutely necessary?*

Answer:—WHEN a single row of radial cylinders are employed on an engine, the number of cylinders must be some uneven number such as 3, 5, 7, 9, 11, in order to complete the firing order evenly among all cylinders in two revolutions. With an uneven number of cylinders, alternate cylinders are fired, going twice around the circle. Thus, with 9-cylinders, the firing order will be: 1-3-5-7-9-2-4-6-8, skipping a cylinder each time. During the first revolution all of the uneven numbers fire. During the second revolution all of the even numbers fire as will be seen from the firing schedule.

* * *

QUESTION:—Jack Allerton, Louisville, Ky. *I understand that it is likely that alcohol will be added to the gasoline by the government in order to increase the demand for farm produce. What effect will the alcohol have on the gasoline?*

Answer:—ALCOHOL added to gasoline tends to suppress detonations, but it has so many drawbacks that they make the use of such mixtures inadvisable. For example, alcohol has a strong attraction for moisture, hence if the mixture were stored any length of time, the gasoline would contain a lot of water, which of course, would be highly objectionable.

(*Concluded on page* 264)

Prof. Pletta Analyzes a Levitator

PROF. D. H. PLETTA, assistant Professor of Applied Mechanics, Virginia Polytechnic Institute, has very kindly taken time to shed some light on the mercury levitator described in the December issue. In addition to its value to levitation, this letter will give our college student readers a little exercise with their calculus.

This is just the sort of discussion that we appreciate, and we again thank Prof. Pletta for his interest in the matter and also for his very wise counsel to handbook fans who usually swallow a formula, hook, line and sinker, without regard to its applicability to the problem at hand.

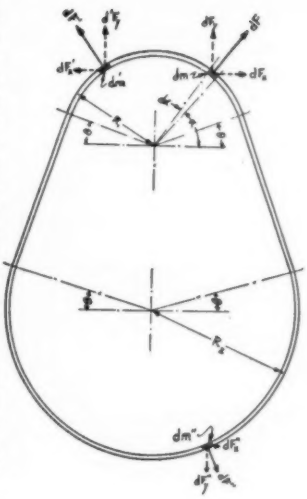
* * *

"The mercury levitator described by Mr. Arthur Cumberland in the December issue of POPULAR AVIATION attracted my attention. The operation of this device involves the principles of applied mechanics and, unfortunately, the 'unforeseen contingency arises to cancel out the lifting force.'

"The inventor of this idea forgets that the mass of liquid in the lower part of the tube is greater and so, even though the normal acceleration (inward) is less here, the net lifting force is zero.

"The differential centrifugal force acting radially outward may be broken into two components dFx and dFy. Since the tube is symmetrical the horizontal component dFx' of the mass dm' balances that of the mass dm and we need consider only the vertical component. In summing up all of these differential vertical components the total upward and downward resultants, being equal, neutralize each other.

"May I take the opportunity to caution your younger readers against consulting handbooks without having an understanding of the limitation of the formulae?"



dm = element of mass of liquid
A = area of tube
k = specific gravity of liquid
g = acceleration of gravity
v = tangential speed of liquid = constant
dF = centrifugal force of "dm"
dV = element of volume of liquid
α = variable angle

$$dm = dV\frac{k}{g} = AR_1 d\alpha \frac{k}{g}$$

$$dF = dm\frac{v^2}{R_1}$$

$$dF_y = dF \sin\alpha = dm\frac{v^2}{R_1}\sin\alpha = \frac{v^2 AR_1 k}{R_1 g}\sin\alpha\, d\alpha$$

$$F_y = \int dF_y = \frac{AkV^2}{g}\int_0^{\pi+\theta}\sin\alpha\, d\alpha = -\frac{AkV^2}{g}\cos\alpha\Big]_0^{\pi+\theta} = -\frac{AkV^2}{g}(-\cos\theta - \cos\theta)$$

$$= \frac{2AkV^2}{g}\cos\theta$$

Similarly — $dF_y'' = \frac{AkR_2V^2}{R_2 g}\sin\alpha\, d\alpha$

$$F_y'' = \int dF_y'' = \frac{AkV^2}{g}\int_{\pi-\theta}^{2\pi+\theta}\sin\alpha\, d\alpha = \frac{2AkV^2}{g}\cos\theta$$

$$\therefore\quad F_y'' = F_y$$

BAROMETRIC FORECASTS
MET-F-50

ANEROID BAROMETER SCALES. Most American barometers, of the ANEROID type, are graduated to read in inches of mercury. The decimal divisions vary with the diameter of the dial, but no barometer should be used that cannot be read down to at least 0.05 in.

In addition to the scale are notations such as "Stormy-Rain-Change-Fair-Very Dry." These have very little significance and should be disregarded. It is the direction of movement and the amount of needle movement that counts rather than the location of the needle at any one time, and further, even this movement is not always of great value unless it is taken in combination with the wind direction.

BAROMETER CORRECTION. The barometric pressures specified by the U. S. Weather Bureau are based upon sea-level readings, hence your barometer must be adjusted to correspond with sea-level pressures should you be located above or below sea-level. If in the vicinity of a Weather Bureau station, it is always best to adjust your instrument with their standard barometer. If this is not possible, then the following table can be used for giving approximate corrections for altitude:

APPROXIMATE BAROMETER CORRECTIONS

(See sheet M-F-52 for altitudes)

Altitude	Add	Altitude	Add	Altitude	Add
250 ft.	0.29 in.	1750 ft.	1.93 in.	4500 ft.	4.72 in.
500 ft.	0.57 in.	2000 ft.	2.20 in.	5000 ft.	5.20 in.
750 ft.	0.85 in.	2500 ft.	2.72 in.	5500 ft.	5.67 in.
1000 ft.	1.12 in.	3000 ft.	3.24 in.	6000 ft.	6.13 in.
1250 ft.	1.39 in.	3500 ft.	3.74 in.	6500 ft.	6.58 in.
1500 ft.	1.66 in.	4000 ft.	4.24 in.	7000 ft.	7.03 in.

EXAMPLE. If observer is at an altitude of 500 feet and his barometer reads 30.51 inches, then add 0.57" to the reading (from above table for 500 feet), or; 30.51" plus 0.57"=31.08", the corrected reading.

TAKING READINGS. When taking a reading, tap the glass of the aneroid slightly with the finger, and note whether the slight needle movement is up or down.

BAROMETRIC FORECASTS
MET-F-51

INTERPRETING READINGS. Remember that the most important observation with a barometer is the amount the hand travels, the rate at which it changes and the direction of travel. Don't place much importance on the words marked on the dial. Tap the dial slightly with the finger when taking a reading and note which way the hand moves. Read down to the smallest decimal—the slightest movement is of importance.

RISING PRESSURE. (1) GENERAL OBSERVATIONS. A gradual and steady rise indicates settled fair weather. (2) A very steady slow rise from a low pressure usually indicates dry weather and high winds. (3) A rapid rise means high winds and clear weather.

FALLING PRESSURE. (4) A gradual steady fall precedes unsettled, wet or snowy weather. (5) A slow fall from a high pressure usually indicates wet weather without much wind. (6) A sudden drop, in clear or fair weather, below 29.0 generally precedes a bad storm by a few hours. (7) Dropping from 30.7" down to 29.6" or intermediate points, generally indicates warmer weather.

SIGNIFICANCE OF RISING BAROMETER

Rises From

29.0" to 29.3"—High winds, cool wave, clearing skies.
29.3" to 29.6"—High winds, squalls, cooler weather.
29.6" to 29.9"—Fair weather. Strong winds tonight and tomorrow.
29.9" to 30.2"—Fair weather, 5 to 10 m.p.h. steady winds, cooler.
30.2" to 30.5"—Generally fair. Cool today. Variable winds.
30.8" to 31.0"—High winds. Rain from the southeast.

SIGNIFICANCE OF FALLING BAROMETER

Drops From

30.7" to 30.5"—Dark and warmer with wind and rain.
30.5" to 30.2"—Storm brewing in direction of wind.
30.2" to 29.9"—Unsettled weather. Cloudy and warmer.
29.9" to 29.6"—Unsettled weather. Warmer. Increasing winds.
29.6" to 29.3"—Slight squalls. Clearing weather. Fair and cool tomorrow.
29.3" to 29.0"—Clearing weather. Squalls or high winds. Cooler.
29.0" to 28.6"—Bad wind storm. Heavy squalls. Local thunderstorm.

GLOSSARY OF WORDS, TERMS AND PHRASES — DIC-A-9

Aileroon. (obsolete). See AILERON.
Air. The colorless gas of which the atmosphere is composed. It consists of 78% nitrogen, 21% oxygen and 1% of other gases.
Air (Atmospheric). The free unconfined outdoor air.
Air-Bag. See AIR BALLONET.
Air-Ballonet. A bag, inflated with air under pressure, that maintains the contour of the outer skin of a blimp or airship by pressing on the gas cells. It compensates for the loss of gas.
Air Bumps. Shocks or jumping due to rough air flying. Rough air is referred to as "bumpy weather."
Air (Carbureted). A combustible mixture, of gasoline vapor or oil vapor with air, for use in an engine or burner.
Air-Carbureter. A device for mixing gasoline or oil vapor with air in the proper proportions for combustion in an engine. See CARBURETER.
Air-Cell. See AIR BALLONET.
Air (Compressed). Air at a pressure greater than atmospheric pressure.
Air-Compressor. A pump for compressing air to a relatively high pressure. Usually of the piston or positive rotary type.
Air-Condenser. (1) A condenser for condensing the exhaust of a steam engine which is cooled by air circulation. (2) An electrical condenser in which air is used as the insulation between the plates.
Air-cooled Engine. An engine having cylinders cooled directly by an air blast acting on the cylinder head and barrel.
Aircraft. Any type of machine used for navigating the air, including airships, airplanes, helicopters, ornithopters, etc.
Aircraft Cable. See AIRCRAFT STRAND.
Aircraft Cord. A very flexible rope or cable made of fine steel wires for connections to controls or where the cable must run over pulleys. Also called AVIATOR CORD.
Aircraft Engines. Light-weight engines for the propulsion of aircraft.

GLOSSARY OF WORDS, TERMS AND PHRASES — DIC-A-10

Aircraft Fittings. Parts used for the connection of aircraft parts, pins, clevises, bolts, cable ends, etc.
Aircraft Fuels. Fuels used in aircraft engines. GASOLINE is the most commonly used fuel, being the lightest and most compact fuel known. It is of higher test than auto gasoline.
Aircraft Speed. The horizontal air-speed without respect to the earth. The air-speed is recorded by the air-speed meter in miles per hour (m.p.h.)
Aircraft Strand. A twisted cable containing from 7 to 19 wires of hard high-tensile strength steel wire. Used for the rigging or bracing of aircraft structures. Also called AVIATOR STRAND.
Aircraft Types. Aircraft are divided into two principal classes: (1) Lighter-than-air craft, comprising balloons and airships. (2) Heavier-than-air types comprising airplanes, autogiros, helicopters and ornithopters.
Aircraft Wire. A hard high tensile strength steel wire used for rigging or bracing aircraft structures. Also called MUSIC WIRE.
Air-Dag. A graphite grease made from AIR FLOATED graphite.
Air-Damped. Oscillations checked or suspended by air-friction.
Air-Datum. Sea-level, from which all atmospheric altitudes and pressures are measured as standard.
Air-Density. (Specific weight). Weight of a cubic foot of air in pounds taken at sea-level and standard temperature (59° F.). This is equal to 0.07651 pounds per cubic foot. Symbol (w).
Air-Density. (Mass Density). Unit adopted by the National Advisory Committee on Aeronautics (N. A. C. A.) for its system of absolute units. Its value is 0.002378 for standard air, or can be derived for other conditions by dividing the specific weight (above) by gravity. This is: $w/g=w/32.17$.
Air Diffraction. The bending of a beam of light when entering the atmosphere from outer space or from a less dense fluid.
Air Diffusion. Passage of air through a wall or membrane by molecular action—not by leakage.

Steel Specifications for Engines

DURING the past few months, we have had so many inquiries regarding the specifications for steels employed in aviation engines, and requests for the meaning of the "S.A.E." numbers, that we have compiled the following tabulated data for a number of American engines.

The Society of Automotive Engineers, or the S.A.E., have developed standard compositions for metals as well as the heat-treatment necessary for developing certain properties in these metals. This insures uniformity in results, and each specification is represented by a number such as, "S.A.E.-1035". Different engine parts require different grades of steel and heat treatment. There is no one "best" steel that will cover all purposes. In general, we have found the rule to be—taken as an average from the manufacturers—as follows:

Parts subjected to heavy stresses—S.A.E.-3135-2330.

Parts to be casehardened—S.A.E.-3312.

Parts to be of high hardness—S.A.E.-3250.

In the following tables, averages were taken from 64 representative makes and types of American aviation engines and for the various parts of these engines. Necessarily, not all of the makers are in agreement as to the specification number of a steel to serve a given purpose, but as a rule, a number of engine builders will adopt the same steel. In such cases, this specification number is enclosed within a parenthesis. If a number of other builders adopt a specification differing from the majority, then this number is written after the parenthesis.

While certain special types of engines differing from standard types may require a different steel for a given purpose, yet the difference in the specifications will not differ greatly. Tensile strength, strength in torsion and hardness are all factors in making the final choice.

TYPICAL S.A.E. STEEL SPECIFICATIONS FOR AVIATION ENGINES

Bolts, connecting rod	(2330), 3140
Bolts, crankshaft	(3250)
Bolts, engine mounting	(3140)
Bolts, miscellaneous bolts	(2330)
Bolts, propeller hub	(2330), 3140
Cam	(3115)
Cam follower	(3115), 2320
Cam ring	(2512)
Camshaft	(3115), 2512
Connecting-rods (Master-rods)	(3140), 3240
Connecting-rods (articulated)	(2340)
Connecting-rods link pins	(3125)
Crankshaft	(3140), 3240
Cylinders, cast iron	1.25% nickel
Cylinders, steel	(3135)
Cylinder heads	("Y" alloy)
Gears, camshaft	(2512), 3140
Gears, crankshaft pinion	(3115), 3140
Gears, magneto	(3140)
Gears, starter	(3140)
Gears, supercharger	(3140)
Gears, timing	(3120)
Key, propeller	(3140)
Nuts, lock-nuts, main bearings	(3135)
Nuts, propeller-hub	(3140)
Pins, dowel	(3140)
Pins, rocker-arm	(3115)
Pins, piston (wrist-pins)	(3120), 3115
Push-rod ends	(3115)
Rocker-arms	(3140)
Rocker-arms rollers	(3115)
Screws, cap	(2340)
Screws, miscellaneous	(3135)
Shafts, accessory drive	(3340)
Shafts, intermediate gear	(3135)
Shafts, magneto	(3140)
Shafts, oil pump	(3140)
Shafts, tachometer	(3240)
Shafts, timing gear	(3140)
Studs, cylinder hold-down	(3140)
Studs, main bearing	(2330)
Studs, miscellaneous	(2330)

It is assumed, in the above specifications, that all of the steels contain nickel as an alloying agent and that all of them are given the proper heat treatment corresponding to the service for which they are employed.

Nickel makes it possible to harden a steel and increase its tensile strength without causing brittleness. Nickel alloy steels are tough and strong.

A Recent Variable Pitch Prop

by HAROLD FRENCH

Variable pitch or multi-pitch propellers have shown their worth in aviation and constant improvements are being made on them. Described below, is a new multi-pitch propeller having decidedly novel points of construction.

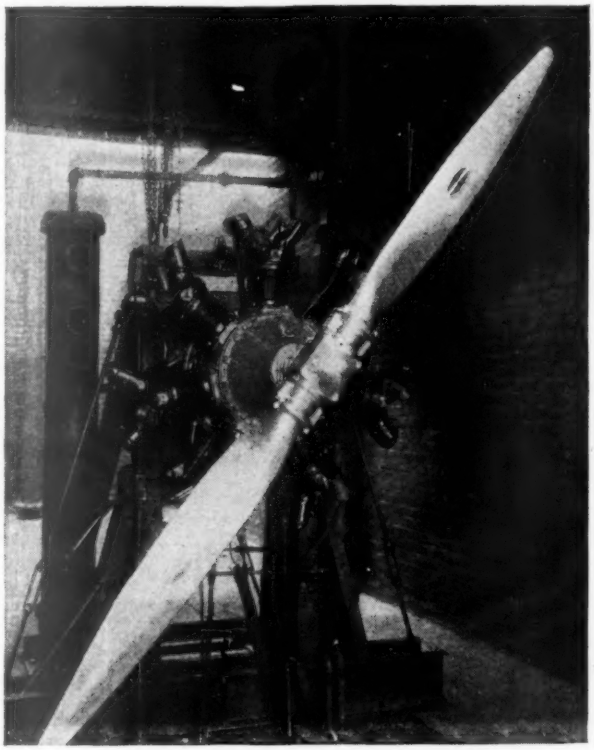
A VARIABLE or multi-pitch propeller, known as the Briner-Huntington Multi-Pitch Propeller, recently introduced, has many novel points of interest.

The pitch of the propeller can be varied through a wide range, a variation of 10 degrees being possible with one model, while a second model permits a variation of 33 degrees pitch angle. As at present constructed, the pilot can change the pitch from his cockpit while the propeller is either standing still or running at 2,200 r.p.m., by simply turning a 4-inch crank. A standard instrument with a 2¼ inch dial indicates the pitch of the propeller at all times so that the pilot is kept informed as to the adjustment of the blades and the pitch speed.

Since the pitch control is accomplished by a rotary motion, it is feasible to supplement present hand-control either from power obtained from the rotating engine shaft, by an electric motor, by a compressed-air servo-motor or even a hydraulic type motor. But, power shift of any type is never as simple and easy as hand control.

The Briner-Huntington propeller differs from other variable pitch propellers in having right and left-hand herringbone splines. They almost absorb the torsion of the blades before the torsional forces reach the pitch control mechanism, and this reduces the pitch shift load with the average propeller to about a 10 to 1 ratio, thus making manual control possible. The herringbone splines move through a separate grease box provided with sufficient grease for the life of the propeller. The power stresses are on the outside with the shift mechanism on the inside.

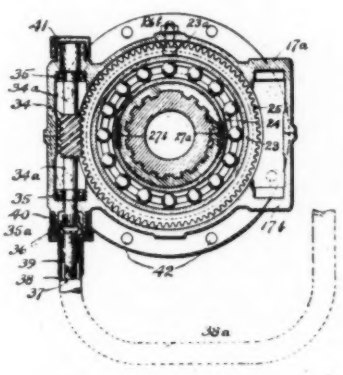
There are two sets of large ball bearings for each blade, loaded at an angle of 45 degrees to the blade axis. The steady centrifugal force on the blades gives a firm clutchlike seating opposing vibratory engine forces taking place at right angles to the centrifugal force. This blade seating is so perfect that it is impossible to detect any looseness in the blade, either at rest or in operation.



The Briner-Huntington Multi-pitch propeller undergoing a test.

A slight elasticity in these bearings, however, loads the bearings evenly and is an improvement over the rigid clamp support of other propeller blades. It undoubtedly reduces or eliminates crystallization.

The bevel gears at the roots of the blades are of the Fellows stub-tooth type and there is no possibility of breaking teeth or gears of this type. Wear can be taken up in these gears by thrust collar shims, but as each gear is doubled meshed (balanced mesh) with those on the spline-shaft, whatever wear does take place is compensated by equal and opposite wear. This insures blade setting accuracy for long service.



A section through the propeller hub showing the worm and worm wheel adjustment.

Each blade unit includes inner and outer ball races, so when the hub is taken apart, the blade with the attached balls, races, blade gears, etc., forms a complete unit and this, of course, greatly facilitates inspection.

The hub is really in three parts, and the split hub when bolted together acts as the blade casing. A shaft sleeve-completes the hub. It is important that the hub shall have no large hole for the engine shaft, for such a hole introduces an element of uncertainty because of the concentrated stresses resulting from the twisting moments introduced by the engine. The shaft sleeve is flanged for the better distribution of the engine torque and this flange is faced with a jaw clutch at the propeller hub with four ⅝ inch bolts to distribute the torque to the hub.

By making a separate splined shaft sleeve, independent of the centrifugal blade load, a member is thus obtained that is more comparable to a splined engine shaft than the ordinary propeller spline, hence this does away with the former objections of poor spline seating encountered with the more common type of spline. Much better bearing and seating distribution is obtained by the new method. And, at the same time, the new shaft sleeve is sufficiently larger in diameter to be of higher harmonic period than the standard engine shaft. It cannot be drawn into synchronism with the engine shaft under any possible conditions.

In general, the Briner-Huntington propeller is placed farther out on the shaft than is common practice, but this is done without adding to the length of the engine shaft nor altering it in the slightest degree. The Multi-Pitch Pro-

(*Concluded on page* 277)

Shop Kinks for Plane Builders

by F. NAGLE

From his extensive experience, the author gives many valuable hints on shop work and building operations that will be of great service to many of our home-builders. To date, very little has been published on this phase of aviation.

BEFORE you start the construction of your ship, make sure that you have the proper equipment for the job, both in regard to tools and shop. Without the proper tools and enough working space you cannot hope to turn out a satisfactory job. Then, too, and most important of all, be sure that your workmanship is good enough to turn out the work as it should be done and not the way you would have it.

Poor workmanship and bad construction, as well as insufficient knowledge of proper construction methods, is responsible for most of the unfavorable attitude towards light home built craft that is shown by the Department of Commerce men and others in authority. Remember that you are hurting yourself and the rest of the lightplaners when you turn out wicked looking jobs, and then complain because the Department of Commerce men turn their thumbs down.

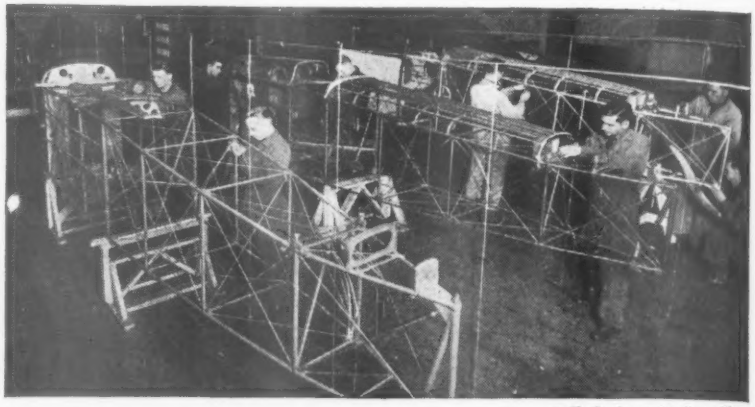
In most cases you can get your ship licensed for non-commercial flying in your state, if it is constructed properly, meets the approval of the local inspector and has Federal identification numbers. You can generally get a state license and fly in your state on that. But your ship will have to be constructed *properly*, and not any old way that you think is right.

While building your ship, you should get a licensed mechanic to look over your work, and you should follow his advice—not that of your friends whose knowledge of ships is generally nil or perhaps "niller" if there is such a word.

And while speaking of mechanics, beware of getting one who has just got his license after spending a year or so working at some field. Most of the present day license holders got theirs by reading up the questions, and spend their year or two washing ships or sweeping hangar floors. Get a man who has spent three or four years actually working on ships, rebuilding them, repairing them, or working on them, so you can be sure of getting some advice that is worth taking.

The author knows many licensed men who couldn't fix a rib nor put a patch on by themselves and yet are licensed, mostly because they had a large mouth and knew the answers to the exam questions. Therefore, get a man to look over your ship who actually knows ships—the kind that talks little and does much.

And now for actual construction notes. To begin with, if your ship is within the lightplane class, the construction will have to be light. There is little power to waste, lugging excess weight around. The ship should be built to proportion and every part built with sufficient factor of safety. Lightness need not denote weakness. By proper construction, the ship can be built rather rugged without being overweight.



—*U. S. Army Air Corps Photo.*

Lining up fuselage in the Army Air Corps Technical school.

However, don't be an extremist and sacrifice strength and safety for lightness. You cannot build your ship as heavy or as strong as regular ships, but a light ship needs to be built that way. You have a ship that flies slower, lands slower, weighs less, and flies about as well as a regular ship and, therefore, do not have to build as heavy, or use structural members as large.

On account of the low weight and power, as well as speed, you can build lighter and yet have the same safety factor as that found in regular ships, and in most cases a factor of safety that will be greater, all things otherwise being equal. However, a lightplane will have to be flown as a lightplane, with proper regard for its limitations, and not as a regular high powered ship. Reserve power is generally meager in a light ship, and this will have to be taken into consideration when flying and judging the performance of lightships.

As most builders prefer to begin with the fuselage, we will start with the proper fuselage construction methods found successful in the lightplane field. Wood is generally unsuited to lightplane fuselage construction. However, present day practice is against it, and steel tube is the more favored as well as the most satisfactory. Welded joints are used extensively, and welding will be found most satisfactory, even though its cost will be greater than riveted or bolted structures.

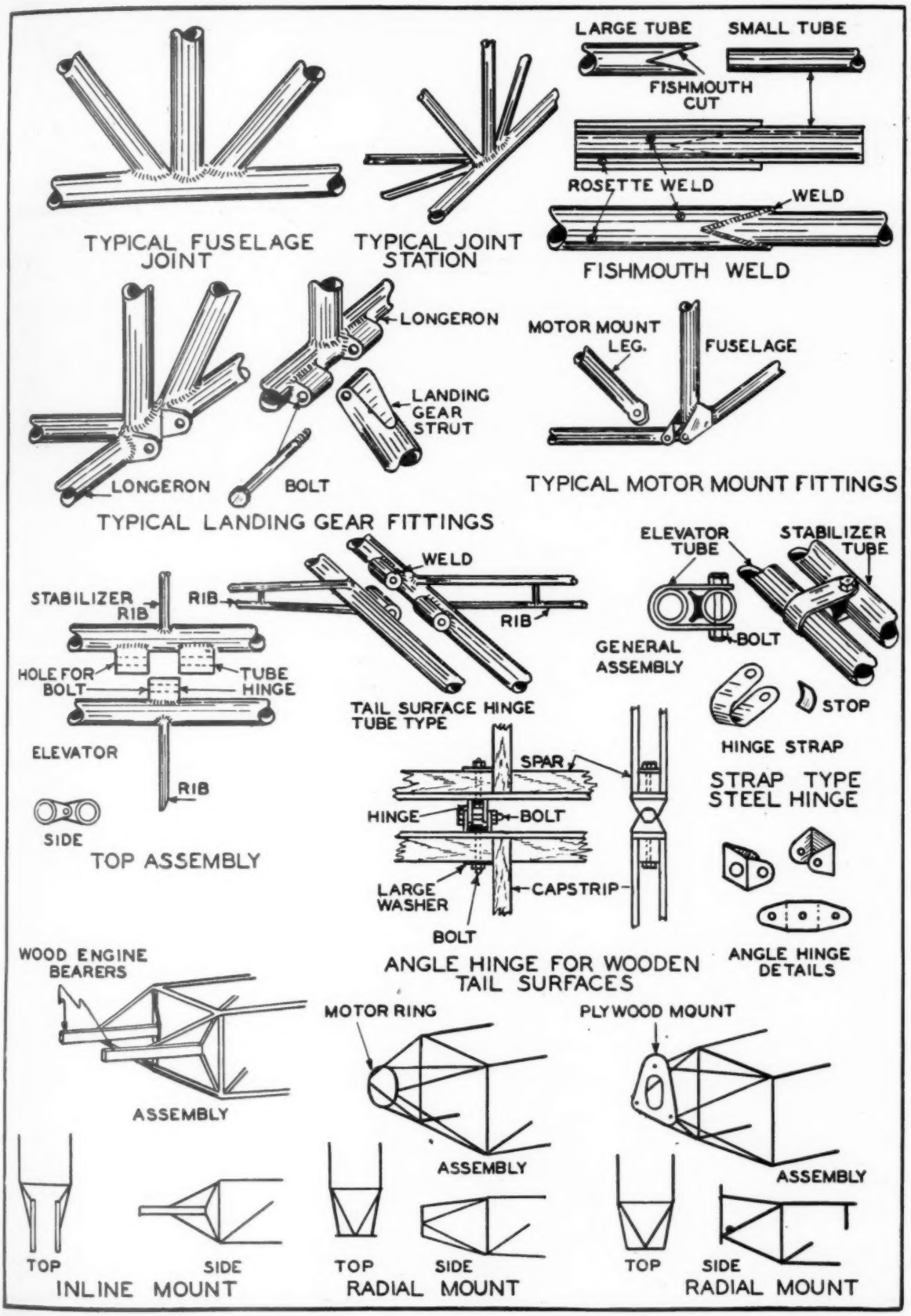
Three different grades of tubing are used; commercial, low carbon 1025 or Shelby and chrome molybdenum. Weight for weight, chrome "moly" is nearly twice as strong as commercial and about half as strong again as 1025. Size for size, chrome moly weighs less than 1025 and is half again as strong. However, Shelby 1025 is good tubing to use if the joints are welded, for heat does not destroy its strength as is the case with chrome moly.

Welds on 1025 tubing can generally be gone over again without losing their strength as is the case with chrome moly. Chrome moly does not lose a great amount of strength where welded, but heat treatment is required if the full strength of the joint is to be developed. For home built jobs, however, heat treatment is impractical or unavailable, and so will not be considered.

The correct sizes of tubing to use can be ascertained from the plans of the ship you are building. If the ship is of your own design, and you are doubtful about the correct sizes to use, the best scheme for you to follow will be to consult the plans of a ship similar to yours as regards to weight, size and power, and use similar sizes in your ship. If chrome moly is specified, and you intend to use 1025 or similar, you will have to get sizes one-fourth again as large as regards diameter and wall thickness, to get the strength required of the member.

This is extremely important if you want a safe ship. When cutting struts, etc., for the frame, allow about a sixteenth less at each end, to allow for

(*Continued on page* 247)


TYPICAL FUSELAGE JOINT
TYPICAL JOINT STATION
LARGE TUBE
SMALL TUBE
FISHMOUTH CUT
ROSETTE WELD
WELD
FISHMOUTH WELD
LONGERON
LANDING GEAR STRUT
LONGERON
BOLT
TYPICAL LANDING GEAR FITTINGS
MOTOR MOUNT LEG.
FUSELAGE
TYPICAL MOTOR MOUNT FITTINGS
WELD
STABILIZER RIB
RIB
RIB
HOLE FOR BOLT
TUBE HINGE
ELEVATOR
RIB
SIDE
TOP ASSEMBLY
ELEVATOR TUBE
STABILIZER TUBE
BOLT
GENERAL ASSEMBLY
STOP
HINGE STRAP
TAIL SURFACE HINGE TUBE TYPE
SPAR
HINGE
BOLT
LARGE WASHER
CAPSTRIP
BOLT
ANGLE HINGE FOR WOODEN TAIL SURFACES
STRAP TYPE STEEL HINGE
ANGLE HINGE DETAILS
WOOD ENGINE BEARERS
ASSEMBLY
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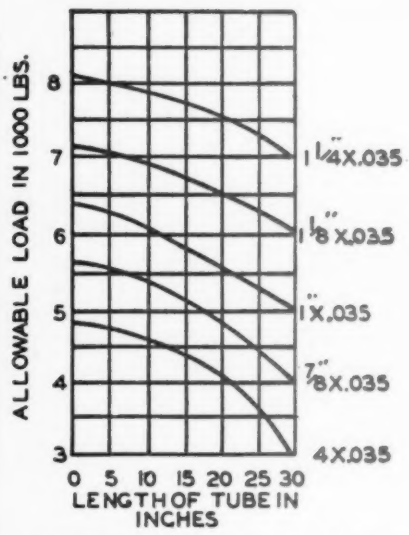
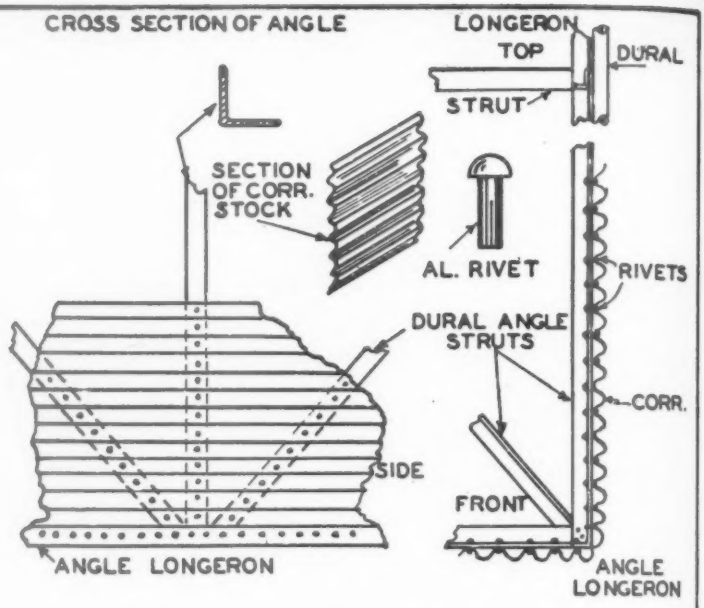
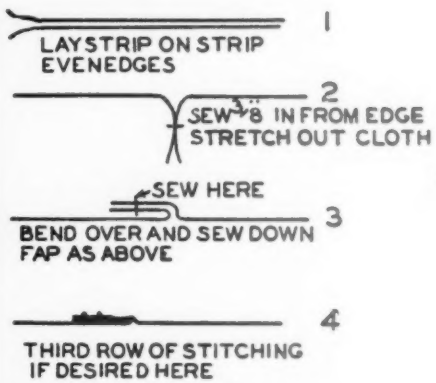


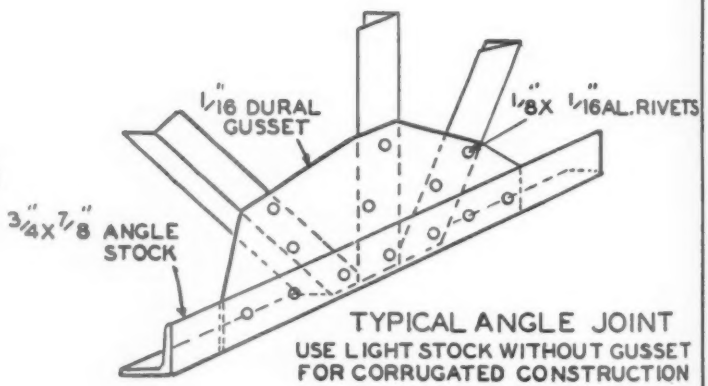
STRENGTH OF CHROME MOLY STEEL TUBES AS COLUMNS FIXITY COEFF 2 FOR WELDED FIXED ENDS



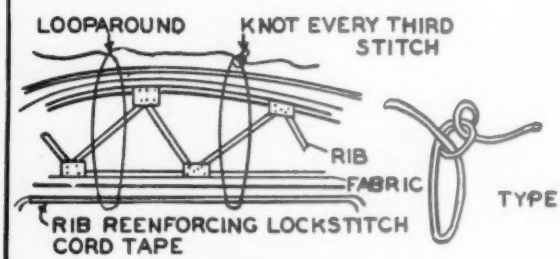
TYPICAL CORRUGATED CONSTRUCTION



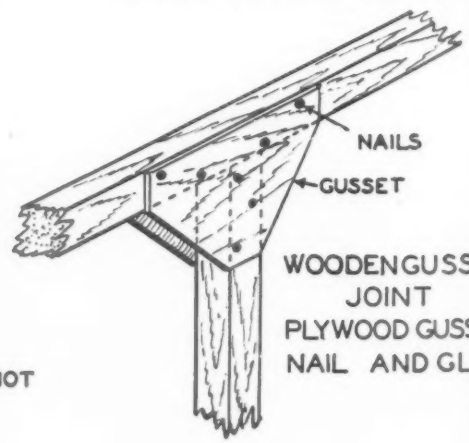
TYPE SEAM USED FOR SEWING STRIPS FOR WINGS ETC. ON MACHINE



TYPICAL ANGLE JOINT
USE LIGHT STOCK WITHOUT GUSSET FOR CORRUGATED CONSTRUCTION



DIAGRAMMATIC SKETCH LOCKSTITCHING



WOODEN GUSSET JOINT
PLYWOOD GUSSET NAIL AND GLUE

Shop Kinks

(*Continued from page* 244)

expansion when welding. The same applies to all tubes that are to be welded at their ends, when used similar to struts in a fuselage. This will save the frame from being warped out of shape while being welded.

It is best to spot weld or tack all the members together, line up everything, check over the works and the weld up the frame, starting at the forward bay, and working in a clockwise direction to the rear. Take each bay in order, and check for alignment while welding after the weld has cooled. Of course, a helper will be necessary.

Welds in tension are to be avoided as a weld is weakest in tension, hence welds in shear or compression are substituted. Fittings, or other highly stressed parts, should be reinforced where welded, for when a member is welded it loses strength around the weld. If failure occurs, it is usually at the edge of the weld. Therefore, make all fittings and similar parts over strength to allow for strength loss due to welding heat.

To prevent crystallization or cracking of fittings it is a good plan to make the fitting of two parts, that is, instead of using a piece of stock a quarter of an inch in thickness, use two pieces each one-eighth inch thick. After cutting each to shape, weld each to each around the edge, except where it is to be welded to the main structure.

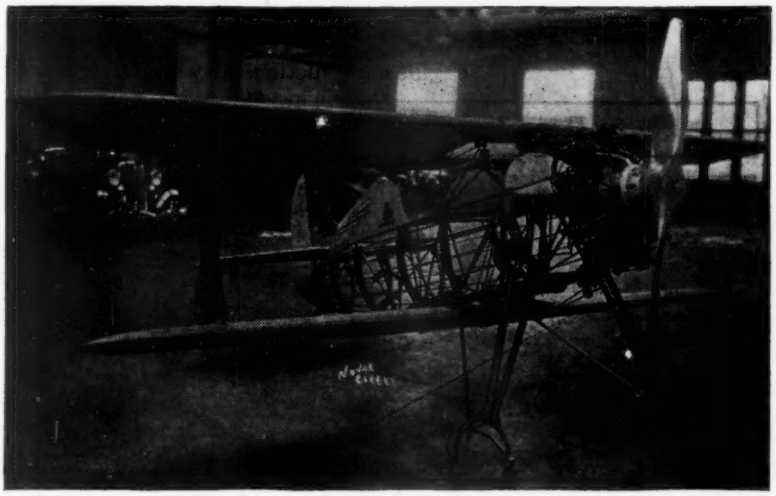
All struts, or compression members, should be of heavy tube as well as the forward part of the fuselage longerons. Tension members may be of lighter stock, as well as struts to the rear of the cockpit. However, no set rule can be supplied as each different design calls for different sizes of structural members. The sketches set forth, types of fittings in use, as well as structural joints, etc.

Some may desire to use sheet metal construction and for their benefit it is sketched. However, it is a tough job to work the corrugated dural that is used and an immense amount of riveting is necessary with its attendant amount of hole drilling. Angle shapes are generally used for longerons and struts and to them the corrugated dural is fastened with aluminum rivets. Dural of around .010 inch to .013 inch thickness is generally used for the skin and ⅛ inch aluminum rivets used for fastening.

For the average lightship angles of dural about ⅞ inch on the side, and from 3/32 inch to an ⅛ inch thick, should suffice for longerons, struts or formers. Thicker sections should, of course, be used for the highly stressed sections. For the average builder, the cost of corrugated dural and angles will probably be more than he wishes to pay and as very few supply houses stock such material, it may be difficult

(*Concluded on page* 277)

New Knight Twister Approaches Completion



The nearly completed Knight Twister as it appears in Vernon Payne's shop. It is equipped with a Salmson engine.

IT WON'T be long now until the Knight Twister will be ready for its test-hops which, we predict, will show up beaucoup M. P. H.

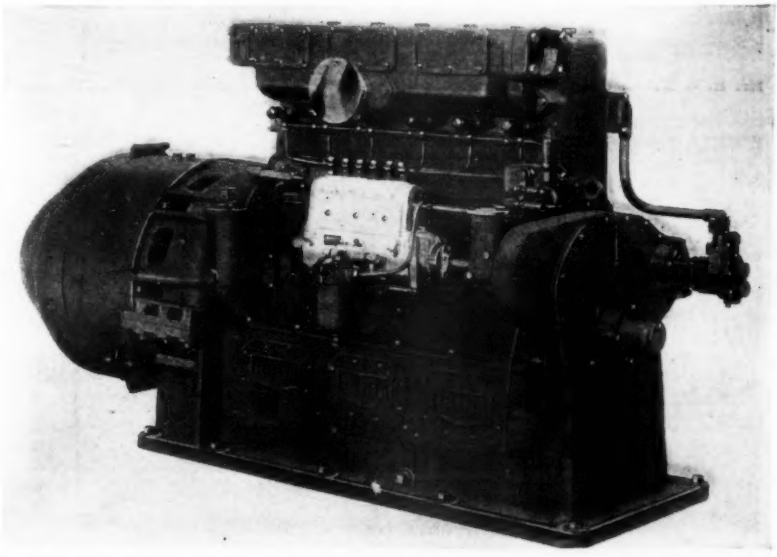
Vernon W. Payne, the well known designer of the Knight Twister, is quite enthusiastic over the prospects open to this little ship and the reception that has been extended to this design by amateurs. Vern, by the way, is an experienced aeronautical engineer and is inclined to be pessimistic than otherwise, so when he says "she's good" it goes a long way with us.

You will, no doubt, remember that we published the preliminary drawings for this miniature pursuit ship some time ago in our lightplane section.

The Buda Diesel Engine for Airports and Shops

WITH the increasing electrical power rates for airport lighting, airplane factories and other industries, in many cities, the latest development of The Buda Company, Harvey, Ill., is of great interest to power users in the aeronautic industry.

This new development is a light compact Diesel generating set that produces current at approximately ¾c to 1c per kilowatt hour. These sets range in sizes from 10 KW to 90 KW, both alternating and direct current. Skilled care is not necessary.

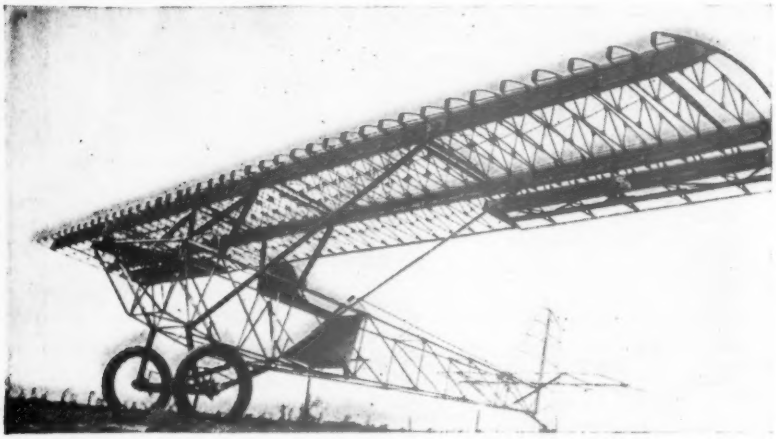


The Buda Diesel engine direct connected to an electric generator. It is adapted for airport lighting and for airplane factories.

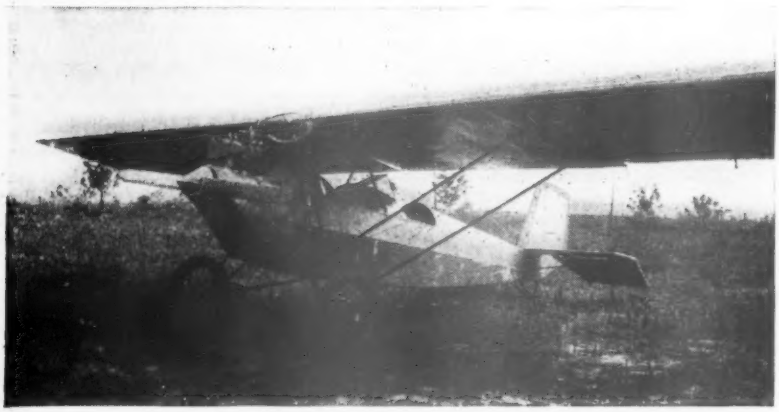
What Our Readers Are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments.

Here Are Three Pietenpol Types



When Gene Kimbell starts out to build a lightplane he builds it right. This is a modified Pietenpol Air Camper built of steel tubing. It will be powered with a Ford "A" engine, converted.



Mr. H. C. Barron turned out a nice little job in the record time of three months. We hope to hear how the test hops came out.

T. L. Kidd also did a good job although the ship was built under difficulties in his home. She's powered with a Velie M-5 engine which gives good performance.

Here's the Story About 'em

GENE KIMBELL, Box 134, Dimmitt, Texas, has contributed a photo of the ship that he has nearly completed. It is similar to the Pietenpol "Air Camper" but is larger and is constructed of steel tubing. A converted Ford "A" will be used for power.

It has a wing span of 30 feet, a length of 19 feet and a Clark "Y" section is used for the wing. We are anxiously waiting for a report on its flying ability and performance.

And now we hear from H. C. Barron, Dublin, Georgia, who sends in a photo of his revamped Pietenpol. He says that it took about three months of his spare time to build it, which is quick work compared with the majority of the bunch.

Because Mr. Barron is not a pilot and for the reason that there is not a decent field within 20 miles of his home, the ship has not yet been test flown, but he promises to send us the dope as soon as the ship is tried out.

Down in San Antonio, Texas, Reader T. L. Kidd built a Pietenpol Air-Camper that is full of interest. He built the ship in his home, under adverse conditions but was awarded with success at the end of his labors.

He was forced to build the wing in three sections instead of in a single piece and was assisted by Mr. Pietenpol in making this change. It is arranged so that the outer wings can be taken off without touching the center-section.

She is powered with a Velie M-5 engine, which as he says, gives her plenty of "soup." Take-off is had in a very short run and she climbs like a pursuit ship. Probably, because of the propeller pitch, the top speed is not very high, but she sails along at about 90 m.p.h. at full gun (1,775 r.p.m.) and cruises along nicely at 65 m.p.h.

Cruising at 1,400 r.p.m., either solo or dual, she flies "hands-off" at this throttle setting. Mr. Kidd weighs 185 pounds and on one trip, a passenger weighing 165 pounds was taken along. With this load of 350 pounds and a tank full of gas, the little ship flew itself off the ground in 500 feet! This is really the sort of performance that we like to read about.

It is interesting to note that this is the second lightplane coming to our notice that was built at home in a room of the house. No doubt this was the reason for building the wing in three sections, though he does not say so in his letter. He has many nice things to say of Mr. Pietenpol who assisted him in every way while the ship was under construction.

Details of a Wing Flapper

PART II.

by

F. J. CAMM

Editor of the English model magazine "Hobbies."

IN OUR last installment we described the construction of the motor mechanism and the method of obtaining the necessary motion for flapping the wings.

It is the purpose of the present article to describe the wing structure which is considerably different from the wings used for model airplanes. The use of thin steel wire for the wings of the ornithopter permits the amount of flexibility that is necessary with the wings used on this class of model. The wing action of an ornithopter is such that the wings beat up and down.

The leading edge of the wing is made from 3/16 inch round birch rod or dowelling, and the ribs are made from No. 20 steel wire passed through holes in this dowelling drilled to receive them. The ends of the ribs are bent over as shown, bound with fine tinned wire and lightly soldered, taking care not to scorch the wood.

The trailing edge is of No. 26 steel wire bent round and soldered to each rib to give the form shown. The leading edge of the wing has attached to it two pieces of telescopic brass tubing as shown in Fig. 1, the inner piece of tubing being secured to the wing spar and the outer piece to the bell crank.

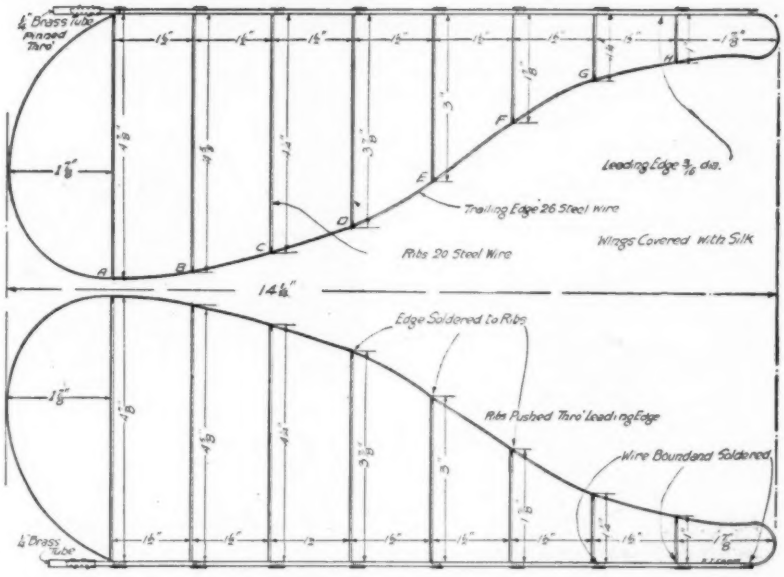


Fig. 1. Details of wing structure for the ornithopter showing outline and the construction and attachment of the frame and ribs.

It will be obvious that as the cranks rock up and down the wings will be reciprocated and thus simulate the action of a bird's wings. These pieces of tubing should each be 1¾ inch long, and their positions should be adjusted before finally pinning the outer piece to the wing spar. The rib sections are shown on Fig. 2, and need no explanation.

Proofed silk should be used for cowling, and it should be stitched to the wings, tail and rudder.

The tail and rudder are constructed from 18 steel gauge wire to the form shown on Fig. 2, and are secured together with the mechanism to a square piece of spruce cut to fit the channel C.

This piece of spruce should be steamed so that the elastic hooks at each end align with those on the mechanism itself. In the photograph shown in last issue will be noticed that only one skein of elastic is used. This is because the wings needed to be fitted so near to the front that the front skein would have been too short to have been of practical use. Where the position of the wing permits, two skeins of elastic should be used. In the first photograph the complete assembly is shown with the wings attached.

This arrangement makes the whole model quickly detachable and easily transportable.

I need scarcely add that I shall be delighted to help any readers should they encounter the slightest difficulty in construction.

The camber or depth of wing curvature should be fully as deep as that shown for the reason that as much air should be trapped by the cupped under surface as possible on the downward stroke, while on the upper or upward stroke, the wings should offer as little resistance as possible. This effect is increased by the flexure of the wing surfaces and without these factors the device is inoperative.

In general, the ornithopter should be hand launched, at least at the beginning, and in most cases it will rise from the hand or at least will start off without losing much elevation. Such little adjustments as may then be found necessary, will suggest themselves to the experimenter.

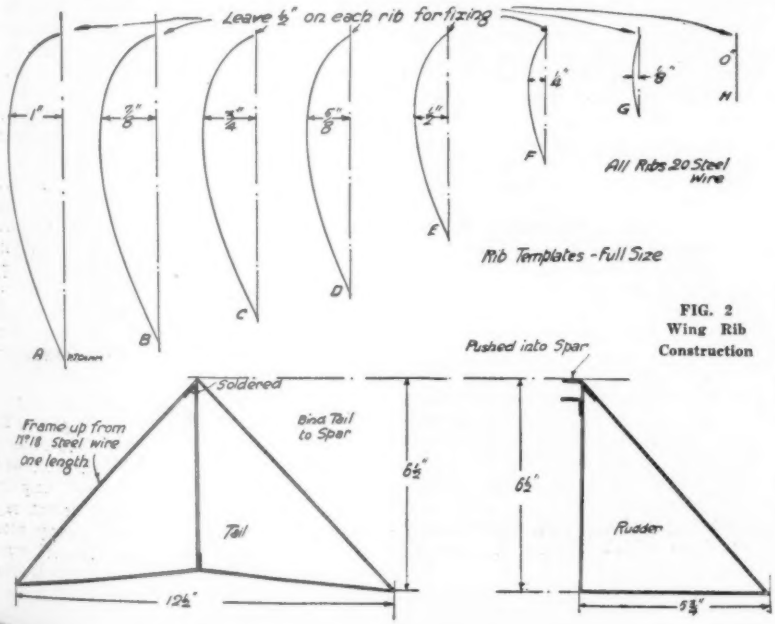


FIG. 2 Wing Rib Construction

Progress of P. A.'s Model Contest

TWENTY beautiful glistening scale models, entered in P. A.'s model contest, have been placed on display at Marshall Field's department store in Chicago and are awaiting the final decision of the judges.

All of them are models of the Boeing "247" low-wing transport plane used by United Air Lines, but it is strange what a great amount of difference there is among these models in the way of workmanship, detail and finish. Many predictions were made, at the beginning of the contest, that it would be difficult to judge these models because they are all of the same type, but this did not prove to be the case at all when the models finally appeared.

And here we wish to congratulate the builders of these models, not only for the beauty and faithfulness of the models themselves, but for the reason that they were all boxed properly, and in the majority of cases, arrived in good condition—intact.

After a few days, we will have a group of qualified judges award the prizes to the most deserving models and will immediately notify the lucky winners of their good fortune. Through the assistance of United Air Lines and the Boeing Airplane Company, as previously announced, these prizes will include an all-expense round-trip transcontinental air trip.

AND DON'T FORGET, the names of the winners and a description of their models will appear in the next (May) issue of POPULAR AVIATION. There will be 20 prizes in all.

To Have Freak Model Contest

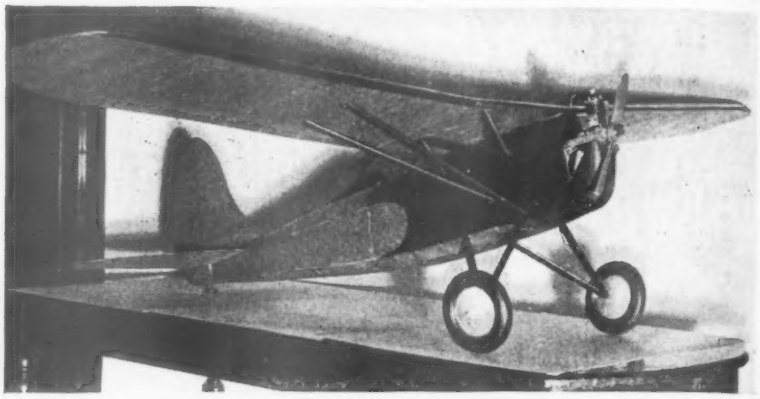
THE faculty and students, Department of Aeronautical Engineering, University of Minnesota, together with the Airplane Model Makers Club of the Twin Cities, are sponsoring the Northwest Airplane Model Originality Contest to be held April 6, 1934. This meeting will be held at 8:00 P. M. in the University of Minnesota Field House.

Ten prizes will be awarded to the models showing the greatest originality in design or construction, both of the flying and non-flying types. The workmanship will have some weight in the awarding of the prizes.

This contest is open to boys under 18 years of age living in the states of Wisconsin, Iowa, North Dakota, South Dakota, Montana and Minnesota. Models from the Northwest may be sent by mail (prepaid) to the Department of Aeronautical Engineering, University of Minnesota, Minneapolis, Minn. All models will be returned (collect) to the owners after the contest.

Notes on Gasoline Engined Model Planes

by LOUIS P. LOUTREL



This gasoline engine powered model has a 6-foot span and weighs 4-pounds, 4-ounces.

INTEREST in the construction of gasoline powered model airplanes is now at fever heat all over the country. The model builders are getting ready for the coming competitions and meets, among the most important of which is the National Contest to be held at Akron, Ohio, in June.

I am showing a picture of the gasoline driven model designed by Benjamin Shereshaw, Newark, N. J., and built by Ludwig Bielko, also of Newark, N. J. It is powered by the latest Loutrel Aero Motor which has a bore and stroke of ⅞" x ¾". The engine is provided with the Bintliff ignition system operated by three No. 2 Burgess flashlight cells.

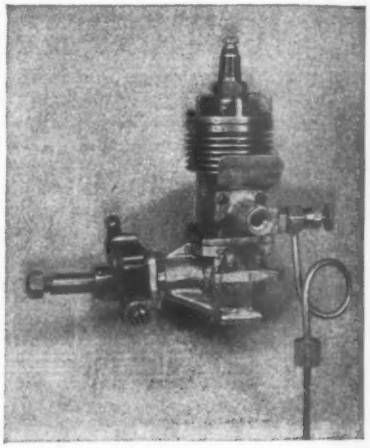
The plane has a wing span of 6-feet, 10-inches and weighs complete ready-to-fly, 4-pounds, 4-ounces. In the test flights, a right-hand aluminum propeller, 13½ inches in diameter and 30 inch pitch was used. It turned about 4,500 r.p.m.

This ship has made several successful preliminary flights and at present is being tuned up for an hour's duration flight. Plans and data will be available at a later date. At present, it takes off within 15 feet, climbs rapidly and makes a perfect three-point landing. The top speed is about 30 m.p.h. and the stalling speed about 12 m.p.h.

The fuselage is built of spruce while the wing structure is of balsa as is the fairing. It is covered with well doped Jap tissue with a black and yellow color scheme. It may be silk covered instead of using the tissue.

When building a model airplane around a gasoline engine of this general type, I suggest that a landing gear be used with a husky equalizer shock absorbing device. This will save the little ship many a crack-up. While the photo shows the model equipped with balsa wheels, these wheels are now being replaced with miniature balloon tires which are much more efficient.

Where gasoline engines are used, metal engine mountings are a necessity. In building the mountings, the engine should not be greatly offset to compensate for the torque. Some inexperienced designers offset their motors 5 degrees or more from the line of thrust in an effort to compensate for torque.



The Loutrel gasoline engine, used on the model above, is a two-cycle type with a mixing valve instead of a carbureter.

An offset of 2-degrees should suffice, or better still, install the engine directly in line with the center of thrust and compensate for the engine torque by increasing the lift on one wing by "wash-in." As you will probably wish to have the ship fly in circles, anyway, this wash-in will accomplish this sort of flight, but take care, however, not to exaggerate this effect too greatly. The rudder should be set about 4-degrees off line.

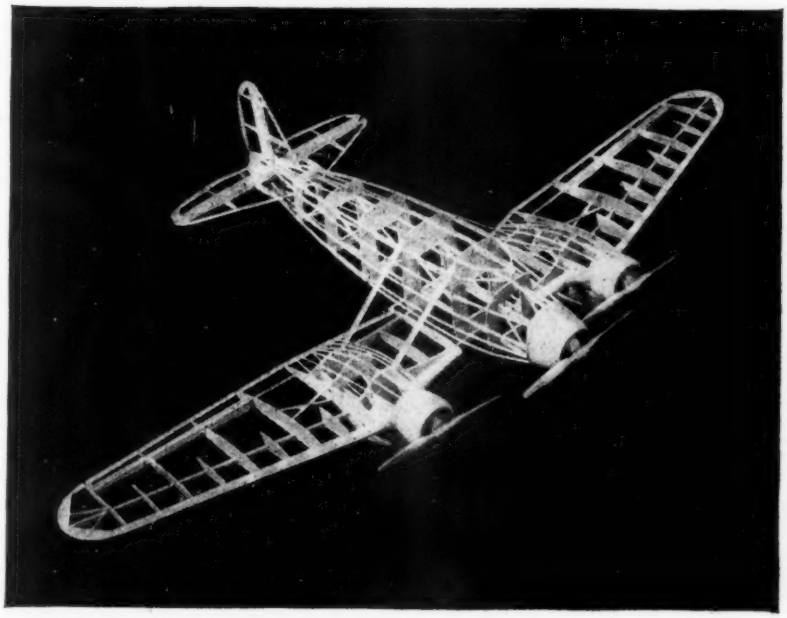
A number of flights have been made recently over the unused portions of Newark Airport by model planes powered with Loutrel engines and invariably they attract any pilot who happens to be about the field. Among the interested spectators was Wiley Post of "Winnie Mae fame" who was quite enthusiastic over the miniature gasoline power plant.

Building a Stinson Air Liner

by

PAUL W. LINDBERG

Airplane model expert and designer of commercial models.



The frame of the Stinson Air Liner model ready for covering. Only the center propeller is active, the two wing motors being dummies. This at once simplifies the construction and improves the performance.

WE ARE more than pleased with the results obtained from the construction and flying of this trim model of the Stinson Airliner.

Our laboratory has taken great care in designing this particular model. It is stressed so that all shocks are absorbed without damage. Flights of 200 to 300 feet are easily obtained. You will marvel at its appearance in flight, for it closely resembles the prototype. So striking is the appearance of this model, that when not being flown, it may be used as a display model.

Every possible improvement is used in the construction of this model, such as the adjustable control surfaces mounted on aluminum hinges, improved nacelle construction and explicit detailed plans which are of vital importance to the model builder.

In building the model of the Stinson Airliner all dimensions can be quickly and accurately determined by placing a ruler on the part to be measured. As the plan is printed full size the model may be constructed upon it. If you wish a larger model, multiply this measurement by the amount of increase.

The color scheme can be obtained from the cover of the March issue of POPULAR AVIATION.

The Stinson covered and ready to fly. She is a surprisingly good flyer and comparatively easy to build. It is to scale in every detail.

CONSTRUCTION OF FUSELAGE

The fuselage sides are built from ⅛ inch square balsa. The longerons, verticals, diagonal braces, etc., are held in place until securely cemented by inserting straight pins on either side of strips wherever needed.

After the two sides are completed, they are pinned to the top of the plan in such a manner that the top longerons face down and the sides form right angles with the surface of the plan. The cross-members are now cemented in their proper locations. Cut formers from 1/32 inch sheet balsa and cement in their respective positions as shown on the plan.

⅛ inch stock is used on front of fuselage, made oval in shape, as shown on plan in order that the 1/32 x ⅛ inch stringers may be cemented to it, and in turn carried over the remaining formers to the rear of the fuselage. Please note that the stringers are cemented to outer edges of formers, this is necessary, to obtain a smooth covering job and it eliminates all projecting formers or bulk heads.

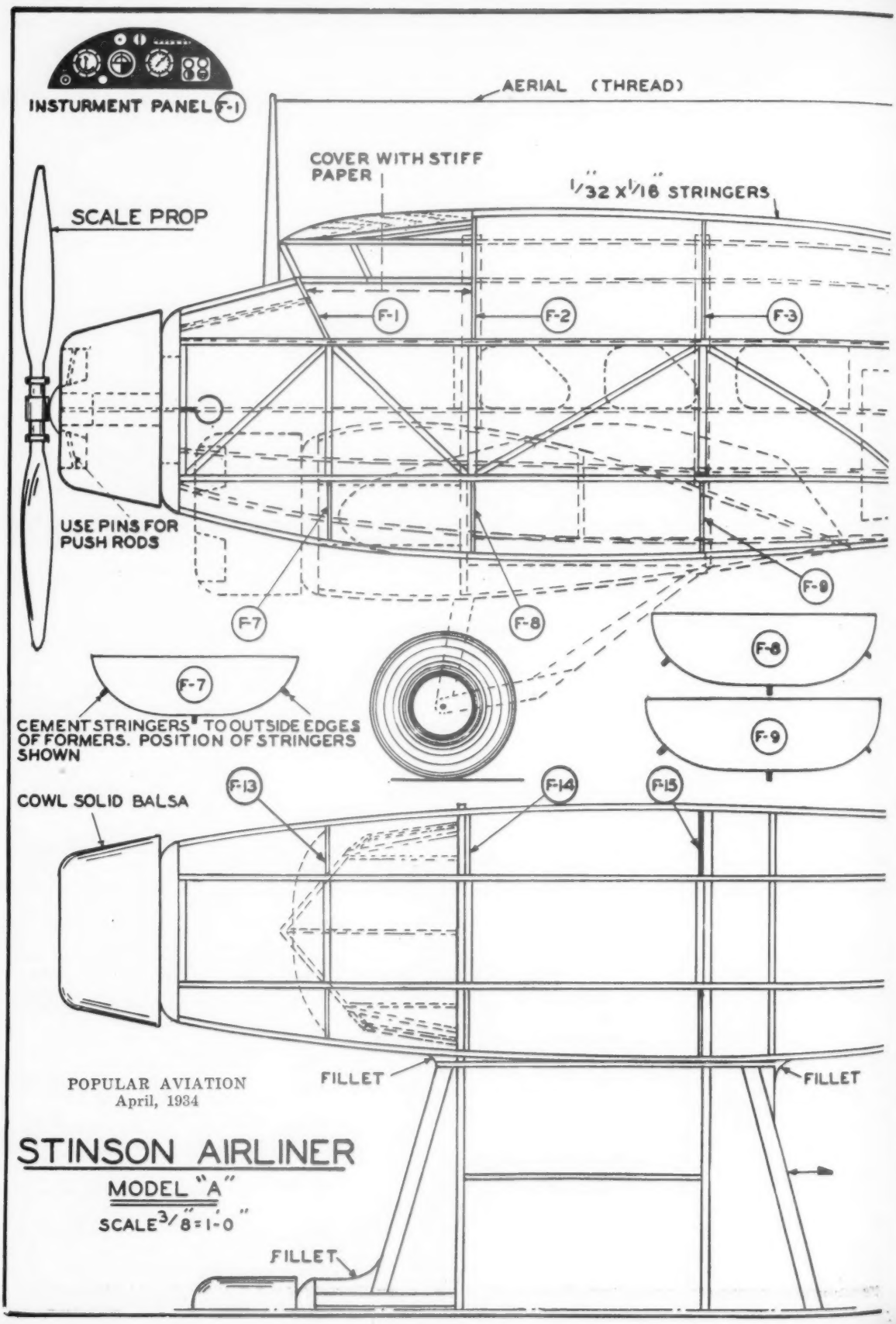
After the framework of the pilot's cabin is completed, use stiff paper between formers (1) and (2) to complete the cockpit enclosure. 1/32 inch sheet balsa is used for window frames. Cement the pieces in their proper locations and make sure they are flush with outer edges of stringers so that when tissue is applied to the fuselage framework there will be no indentation in fuselage sides around the windows.

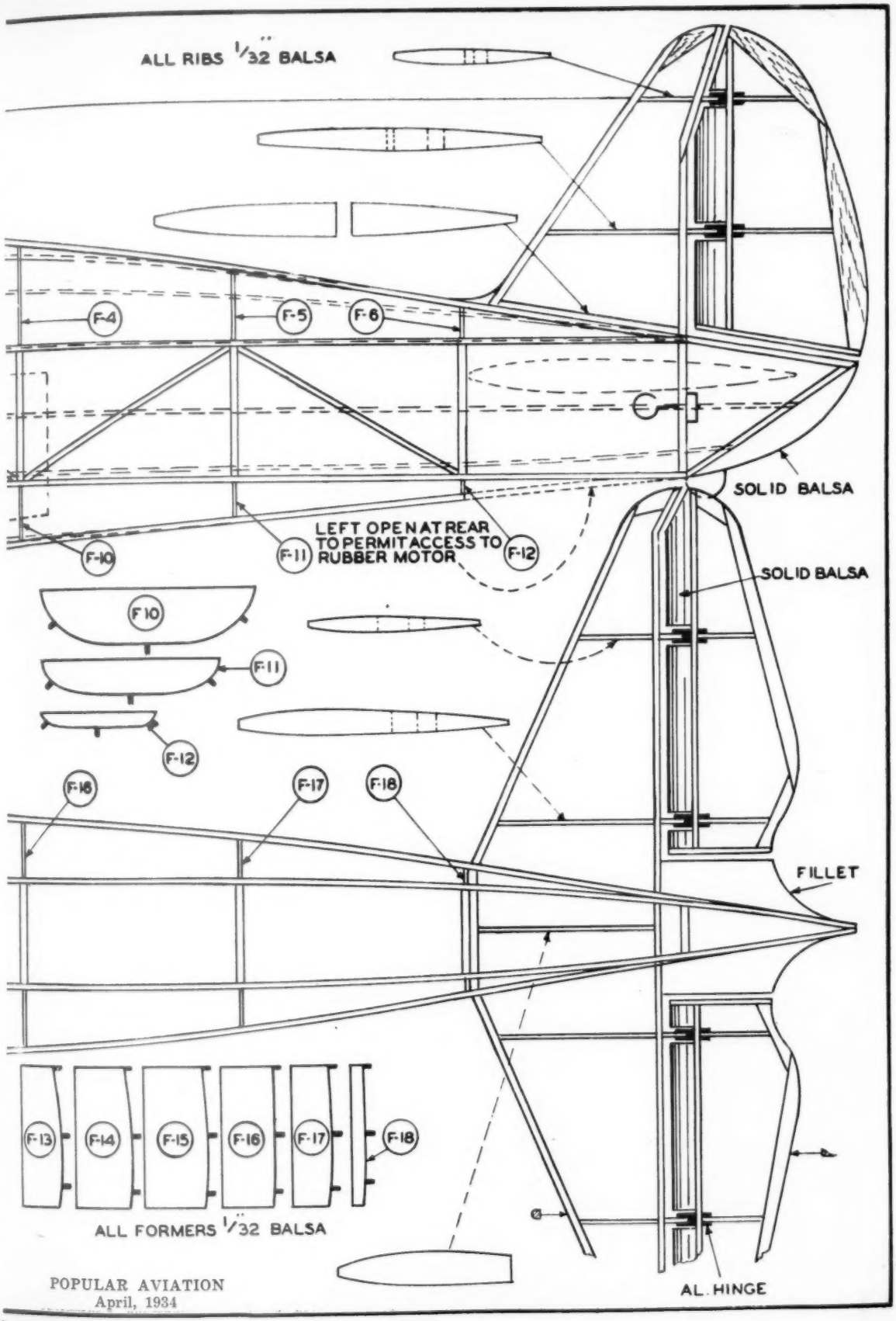
Please note the solid piece of balsa at extreme rear of fuselage, this is neatly carved to shape and sanded, after it has been cemented in position the tail wheel is cemented to bottom of this block.

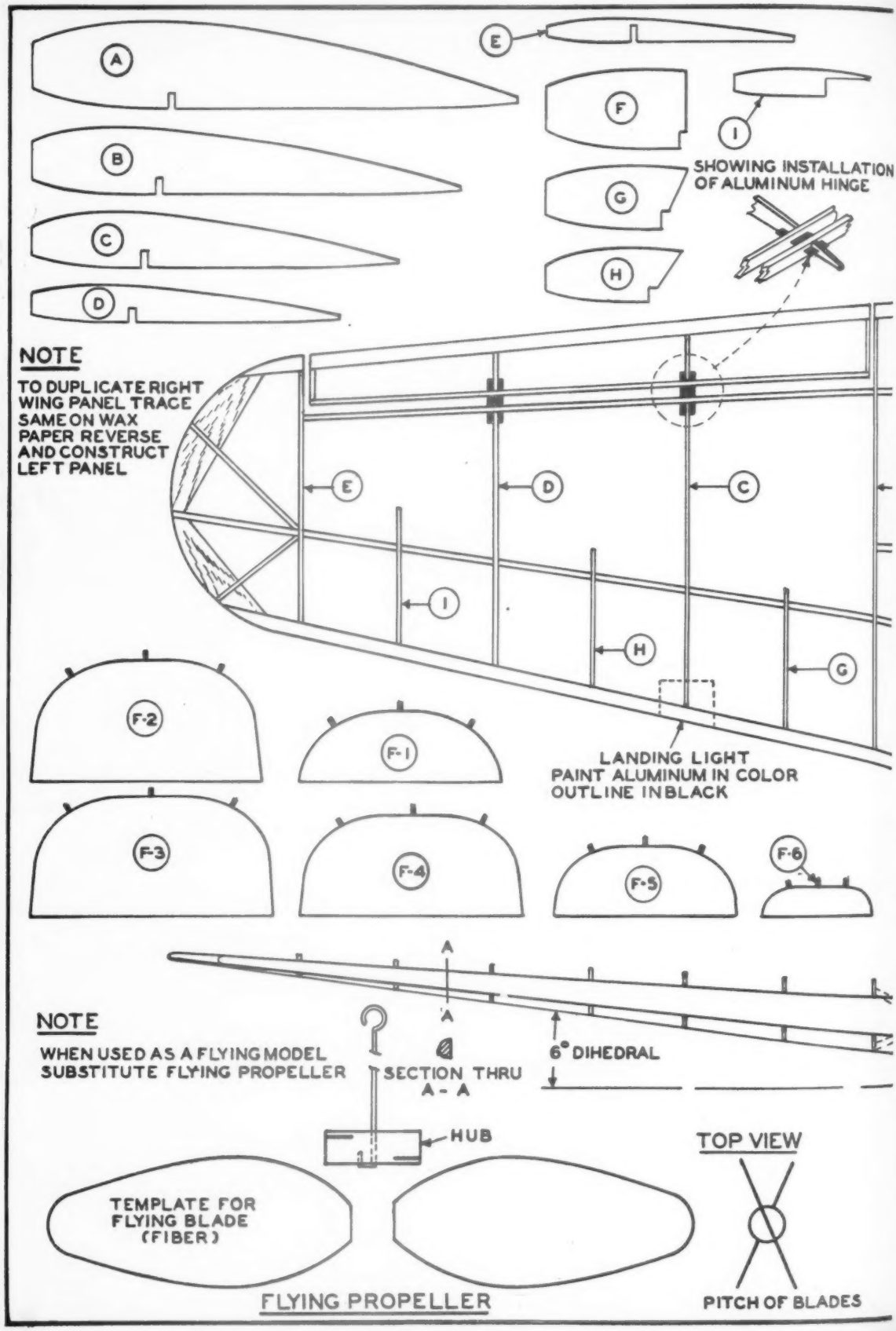
DUMMY MOTORS AND COWLS

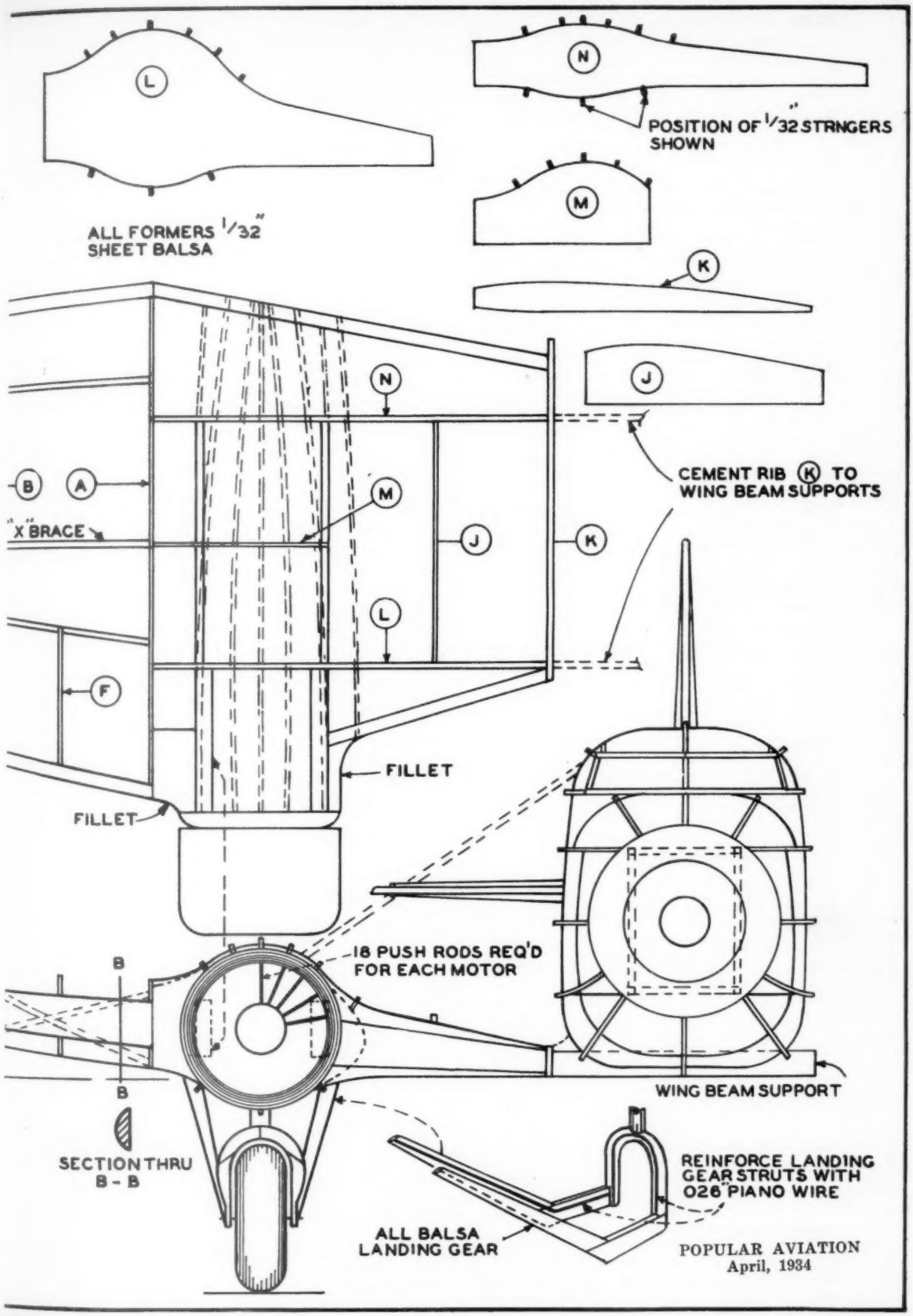
The cowls are constructed from solid blocks of balsa with the utmost of care to obtain a cowl which is cylindrical in shape. Ordinary pins are used for

(*Continued on page* 256)


INSTURMENT PANEL F-1
AERIAL (THREAD)
COVER WITH STIFF PAPER
1/32 X 1/16 STRINGERS
SCALE PROP
F-1
F-2
F-3
USE PINS FOR PUSH RODS
F-7
F-8
F-9
F-6
F-7
CEMENT STRINGERS TO OUTSIDE EDGES OF FORMERS. POSITION OF STRINGERS SHOWN
COWL SOLID BALSA
F-13
F-14
F-15
FILLET
FILLET
FILLET
POPULAR AVIATION
April, 1934
STINSON AIRLINER
MODEL "A"
SCALE 3/8"=1-0"


ALL RIBS 1/32" BALSA
F-4
F-5
F-6
SOLID BALSA
LEFT OPEN AT REAR TO PERMIT ACCESS TO RUBBER MOTOR
F-10
F-11
F-12
SOLID BALSA
F-10
F-11
F-12
F-16
F-17
F-18
FILLET
F-13
F-14
F-15
F-16
F-17
F-18
ALL FORMERS 1/32" BALSA
AL. HINGE


A
B
C
D
E
F
G
H
I
SHOWING INSTALLATION OF ALUMINUM HINGE
NOTE
TO DUPLICATE RIGHT WING PANEL TRACE SAME ON WAX PAPER REVERSE AND CONSTRUCT LEFT PANEL
E
D
C
I
H
G
LANDING LIGHT
PAINT ALUMINUM IN COLOR
OUTLINE IN BLACK
F-2
F-1
F-3
F-4
F-5
F-6
A
A
NOTE
WHEN USED AS A FLYING MODEL SUBSTITUTE FLYING PROPELLER
SECTION THRU A - A
6° DIHEDRAL
HUB
TOP VIEW
TEMPLATE FOR FLYING BLADE (FIBER)
FLYING PROPELLER
PITCH OF BLADES



POPULAR AVIATION
April, 1934

Stinson Air Liner

(*Continued from page* 251)

push-rods, which gives a very snappy appearance to the business end of the model. Do not install the push rods until cowls have been painted as pins are left their original color.

CONSTRUCTION OF WINGS

Cut all ribs from 1/32 inch sheet balsa. Lay a sheet of wax paper upon the plan and pin the center spar in position. The ribs are now placed in an upright position in their proper locations and cemented. The leading and trailing edges are now cemented to the ribs. Make wing tips as shown on plan from $\frac{1}{16}$ inch sheet balsa. Reinforce tips with diagonal braces shown on plan. Having carefully studied the construction of the motor nacelle, you may start building this together with the wing stub, which is built in one unit, cement this securely to the rest of the wing.

The stringers and fillets may now be added. In making the fillets, first cement the blocks in their proper places. By using a razor and piece of sand paper their shapes may be easily obtained.

The ailerons are now built into the panels. The ailerons will eliminate the need for building wash-in into the wing. We recommend that you build this model with all removable controls, as you will need these to control your model under flight.

TAIL GROUP

This is made entirely of balsa and is constructed upon the plan. Please note the solid balsa pieces along elevator, leading edge and rudder trailing edge, these are to give the appearance of balanced areas.

Cover each part separately with tissue, as this simplifies covering these portions after model is completely assembled. Aluminum hinges are cemented into position after framework has been completely covered, so that tissue will be taut.

LANDING GEAR

After selecting a strong grade of balsa, the landing gear struts should be shaped and sanded as shown in prospective on plan. Reinforce the landing gear struts with .026 piano wire. The piano wire is cemented securely to the arch and side struts.

FINAL ASSEMBLY

Cement the two wing-beam supports to the bottom of the fuselage, so that they will receive rib (K) at root of wing stub. After blocking wing tip so that it has a 6 degree dihedral angle. Apply cement to rib (K) at wing-beam supports. After these parts have become thoroughly dry, proceed to cover your model with tissue paper. In covering the fuselage cut tissue into long narrow strips and work one panel at

(*Continued on page* 277)

Building the Clark GA-43 Replica

by JACK KNOBLE

THE fuselage is carved from balsa, (1¾" x 1½" x 10¼") and a notch is cut out of the fuselage where the wing is inserted as shown by dotted lines on the side view. Sand the fuselage and give several coats of shellac, sanding after each coat.

Make the wing out of 2 pieces of balsa 7" x ½" x 3". Cut out the rough shape first, then give the wing its dihedral, then cement the whole wing in the notch in the fuselage and carve it to the finished shape.

Carve the cockpit hood and the wheel covers, then cement them in place. Also carve the tail sections out of ⅛" flat balsa and cement them in place.

Take wood filler and use it for streamlining where the wings join the fuselage and where the tail sections join the fuselage.

Now coat the whole plane with shellac and after it has dried thoroughly, sand it to a very smooth finish. Now give the plane two coats of glossy white paint, waiting until the first has dried before applying the second.

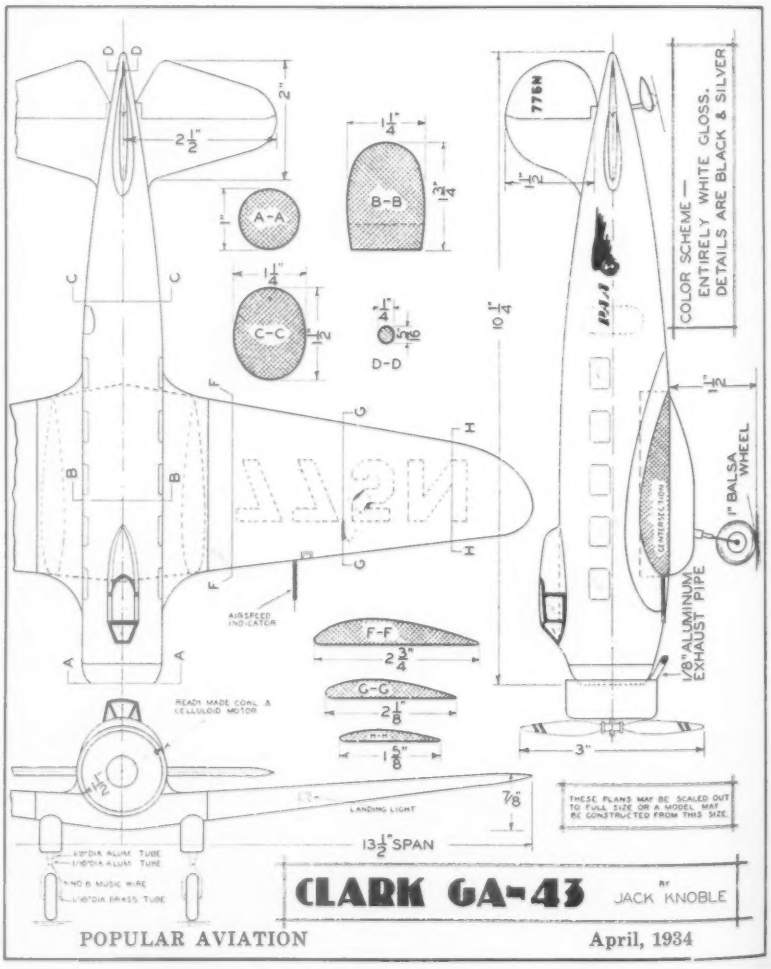
The motor mount is a cowl ring, (such as bought in a model supply house), which has a celluloid motor inside. This assembly is cemented to the nose of the ship. After this has dried in place add all the details.

The landing gear is the retractable type which is in a landing position. This is constructed by using several sizes of aluminum tubing and piano wire and cemented in place.

The propeller is all balsa and is painted silver with black striped tips. The windows are painted on with silver paint and edged with black paint. The door is on the right side of the plane and is also painted on.

Now that our model is completed, we must think up some means of supporting it because, if it is allowed to stand around on the landing gear, it is certain to be broken.

One method is to turn a pedestal on your lathe—turning a piece of hardwood in a gracefully tapered form from the round base to the small pointed end where it is driven into a hole drilled in the bottom of the mounting.



What the Industry is Doing

Latest bulletins from the airplane, engine, equipment manufacturers and dealers boiled down into a nutshell. Contributions to this department are invited.

LIGHTED AIRWAYS will be extended by the PWA $1,187,478 allotment to the Aeronautics Branch, Department of Commerce. This will include five new lighted airways forming part of the Federal chain.

EVANS APPLIANCE CO., Detroit, Mich., have just placed a new aircraft fuel pump on the market known as the model E-8, that will operate for 5,000 hours. By the use of a flexible shaft, an internal relief valve and a sylphon seal, a constant pressure is maintained at all times to the carbureter and there is no danger of bending or breaking the shaft in case that the pump is out of alignment with the engine.

MIDWEST AIRWAYS, INC., Milwaukee County Airport, Milwaukee, Wis., has opened a ground school course. This covers the usual subjects of airplanes, engines, navigation, meteorology, etc. The term is for 6 months and is handled by Dwight S. Mills.

RAPID PROGRESS is being made by Vernon W. Payne in the construction of the diminutive "Knight Twister" biplane that has been described in past issues of P. A. This type of single-seater lightplane presents many advantages and, judging from our correspondence on the subject, has awakened a great deal of interest among our lightplane fans.

SLIP-STICK pushers, more properly called draftsmen, engineers and students, will be interested in a new slide-rule being marketed by the Industrial Engineering Company, Bridgeport, Conn. This rule is 6 inches long is exceptionally well built, having a chromium plated back, a crystal clear runner and solid celluloid faces.

GRAPHITE IS coming into its own as an aviation engine lubricant.

THE BEE-HIVE is a mighty interesting 12 page magazine issued by The Pratt & Whitney Aircraft Company, Hartford, Conn. The January issue lying before us has much interesting material on the part played by P & W engines in the Coast Guard Service, in the Herbert Schiff Trophy Prize and on the new clipper ships operated by Pan-American Airways.

KARL ORT, 704 W. Polar St., York, Pa., has just issued a very comprehensive catalogue of great interest to the pilot and home-builder. This catalogue, which will be sent for 10 cents, covers a wide range of materials, appliances and replacements of use to every one engaged in aviation.

RALPH DAMON, president of the Curtiss-Wright Airplane Company, St. Louis, announced that 31 Curtiss Condors had been sold up to January 1, this year. This represents sales approximating $2,000,000.

GENERAL AIR EXPRESS announces that it handled shipments weighing 429,149 pounds last year, or 46 per cent of all the air express handled in this country. The volume of shipments increased 41 per cent during the second six months of 1933 while the weight increased by 42 per cent.

AMERICAN AIRWAYS has completed a new overhaul base at the Chicago Municipal airport where all major repair and service work for the eastern division of American Airways will be concentrated. It includes every facility for every service ranging from spark plug cleaning to the complete overhaul of the planes and engines.

WRIGHT FIELD is to have two new buildings —a Static Test Laboratory and a Technical Data Building. These buildings will cost $107,000 and $200,000 respectively. The drawings have been completed and work will start within a few weeks.

BELLANCA AIRCRAFT CORPORATION, New Castle, Dela., has just issued the interesting booklet on Bellanca products, "Bellanca Leads the Way." This booklet gives many useful facts in respect to Bellanca planes, such as specifications for the Pacemaker and Skyrocket, records established by Bellanca planes, etc.

THE WINGS of the Boeing "247" are capable of withstanding a load of 36½ tons although the gross weight of the plane is only 6½ tons. Many a highway bridge will not bear up under a load of this amount and the weight of the bridge is many many times greater.

SMITH-TABER, consulting engineers, North Tonawanda, N. Y., have introduced a precision Stiffness and Resiliency Tester. This instrument accurately determines the stiffness and elasticity of flexible materials such as paper, cloth, thin metals, etc. It covers the great range of materials employed in airplane construction and should therefore find application in the laboratories and testing departments of airplane manufacturers.

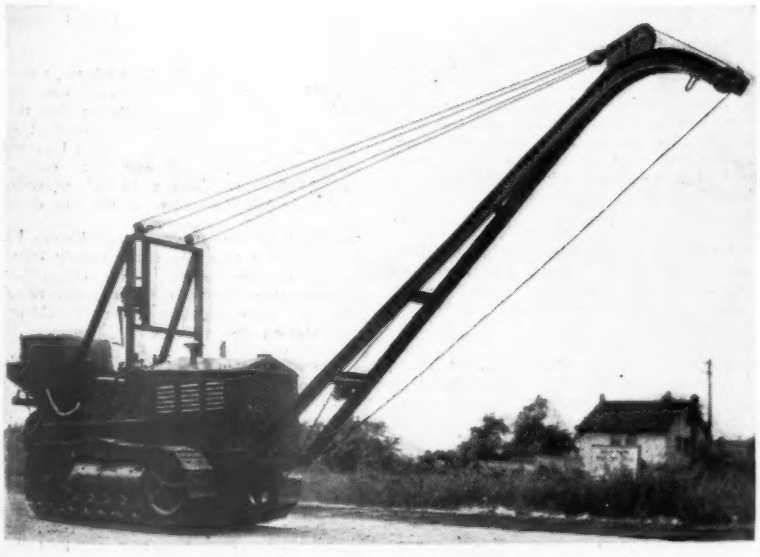
O. G. CORBEN of the Corben Airplane Company, Madison, Wis., announces that their latest product is now under examination for its A. T. C. and that the prospects are very bright for the sale of this efficient lightplane.

TRANSPORTES AEREOS, Mexico City, Mexico, has organized an air route between Mexico City and Acapulco, a distance of 395 miles. Daily operation with passenger, mail and express service is announced. Air transportation in Mexico is growing and will prove of great benefit in this country of great distances and rugged terrain.

RADIO MANUFACTURERS have turned their attention to the requirements of the private plane owner, and based upon their experience with automobile radios, are turning out excellent equipment for aviation service. Thanks to the active competition, the prices are coming down rapidly, and an airplane radio will no longer be a luxury but will prove as necessary as a speedometer on a car.

A RECENT VISITOR to our offices has made an accurate survey of the airlines in the various European countries. He lauds the equipment and service on the British lines, and states that the giant airliners of the Heracles type are practically noiseless even at full speed. Great Britain leads in Europe, according to his opinion, in planes, equipment, service and maintenance.

PARKS Air College, East St. Louis, Ill., is now the distributer of Universal propellers for the districts of Indiana, Arkansas, Southern Illinois and Eastern Missouri.



The Cletrac tractor for airport construction.

(*Concluded on page* 258)

Waco in 1934

MORE POWER • MORE SPEED
MORE ROOM • MORE COMFORT

★

—the result of advanced airplane engineering—tried, tested and proved—and embodied in these superb ships—

FOUR-PLACE CABIN WACO
THREE-PLACE SPORTSMAN'S MODEL
NEW SUPER-SPORT MODEL
(HIGH POWER... HIGH SPEED)

All fully illustrated and described in our special March edition of WACO PILOT. A copy will be sent upon request without cost or obligation.

THE WACO AIRCRAFT CO., TROY, O.

WACO AIRPLANES
"ASK ANY PILOT"
WACO LEADS IN AIRCRAFT REGISTRATION

Industry

(*Continued from page* 257)

The Universal propeller is a high grade wooden type which can be had in the proper diameter and pitch for practically all modern engines including the Warner, Wright, Kinner, Lambert, OX5, Aeronca, Cirrus, Challenger, LeBlond, Continental, Velie and many others.

TWO of Europe's greatest airplane engine builders, Rolls-Royce of England and the Hispano-Suiza Company of France, will be sub-licensed to manufacture the salt-cooled valves developed by the Eaton Company, Mfg. Company, Cleveland, Ohio. The licenses were taken through the Bristol Engine Company of England, the European licensees of the Eaton Company.

ACCORDING to the Railway Express Agency, Inc., the air-express has passed the emergency shipment phase, and has now become an important factor in the nation's transportation system. In the number of shipments handled, the air-express has shown a gain of 166 per cent for 1933 over the previous year. The gross revenue has increased by 129 per cent.

AT THE conclusion of its regular schedules on February 15, United Air Lines passed its 65,000,000th mile of scheduled flying, maintaining its supremacy as the leading air line in the world in point of flying experience. Approximately, 29,000,000 miles of this distance was flown at night.

A $3,500,000 program, calling for the replacement of flying equipment, was completed by Transcontinental and Western Air by the selection of the 700 h.p. Wright Cyclone engines for the twin-motored Douglas transport planes being built for the TWA.

ONE of the tests made of the engines entered for the TWA service was a take-off with the full load of 17,500 pounds from the Winslow, Ariz., airport which is 4,500 feet above sea-level. One engine was cut out after the plane had travelled down half of the runway. The plane continued its take-off and climbed to 9,000 feet on the one engine.

A NEW aerial camera, known as the "Cyclops" camera, is being marketed by the Fairchild Aerial Camera Corp., 62-10 Woodside Ave., Woodside, L. I., N. Y. This is a low-priced aerial camera designed for the use of owner-pilots or commercial operators who wish a less expensive equipment than has been sold in the past. It weighs less than 15 pounds and costs less than $200.

KARL ORT, York, Pa., reports excellent business in the sale of airplane supplies and equipment. His catalogue, which embraces a great variety of aviation equipment will be mailed for 10 cents.

BUSINESS is good at the Lockheed plant where they are producing Lockheed Orions and the new Lockheed Electra all-metal ship. The net earnings during the third quarter of 1933 jumped to $20,282.70 or a total of $48,39.98 for the year. The earnings in the third quarter of 1933 were greater than for the preceding nine months.

ACCORDING to Capt. E. V. Rickenbacker, world war ace, the most notable developments during 1933 were the development of acoustical methods by which noises are silenced on transport ships, the development of the wing-flap and the adjustable pitch propeller. Sorry, Captain, but all of these devices were invented years ago.

TWO new airplane radio receivers have been marketed for use of the sportsman pilot. They are the RCA receiver and the receiver and transmitter being sold by the Lear Development Company, 847 W. Harrison St., Chicago, Ill.

TRANSPORTS of the American Airways, on their coast-to-coast Canada to Mexico service, fly more miles per month than all of the airways in Europe combined.

FOUR WACO models are now being produced by the Waco Aircraft Company, Troy, Ohio. The Waco "A" is a two-place side-by-side open or closed ship which can be provided with either a 170 h.p. Jacobs or a 210 h.p. Continental engine. The Waco "C" is a four-place cabin plane powered with a 210 h.p. Continental engine. The Waco "F" is a three-place open ship powered with a 110 h.p. Warner engine. The Waco F2 is a super-model of the Type "F" with either a 170 h.p. Jacobs engine or a 210 h.p. Continental.

COURSES are being extended in The Aeronautical University, 1338 S. Michigan Ave., Chicago. The time required for the aeronautical engineering course has been extended to eighteen months. Radio has been added to the master mechanic's course so that the graduates will have an opportunity of applying for the operator's license. Radio is becoming highly important in aviation.

BEARING the title, "Across the Skyways With United Air Lines," a 24-page booklet has been issued by the Publicity Department of United Air Lines, LaSalle-Wacker Building, Chicago, Ill. This booklet is full of "behind the scenes" information of interest to everyone who is considering a trip by air.

PARKS Air College, East St. Louis, Ill., has been appointed distributor for Waco Aircraft and are planning an aggressive sales campaign. The Parks mechanics are well acquainted with the Waco line and complete service will be given to owners of Wacos at the Parks Approved Repair Station.

LOUIS P. LOUTREL, 96 McDonough St., Brooklyn, N. Y., has placed a small two-cycle model airplane motor on the market that is attracting a considerable amount of attention. This little engine has a bore and stroke of ⅞ x ⅞ inch and turns over at 4200-4500 r.p.m. with a 14-inch propeller. It weighs only 12 ounces in working order.

THE LEAR DEVELOPMENT CORP., Chicago, Ill., has placed a new low-price airway transmitter on the market. This transmitter employs ordinary radio tubes, is low priced and very economical in operation. It put 10 watts on the antenna.

AUTOMOBILE MANUFACTURERS are intently watching the progress of the $700 lightplane project recently proposed by the Department of Commerce. Whether this is to be a life-saver for the aeronautic industry or just another side line for the automobile industry is yet to be seen.

FLY AIR-MAIL in Army pursuit planes and attack planes may last for a time, but sooner or later this method will be found inadequate.

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Airy Chat

(*Continued from page 212*)

STILL ANOTHER suggestion comes from A. A. Schermerhorn, Milwaukee, Wis. He, to quote his letter, is an "ardent model builder," so here's his big idea:

I think that a set of model drawings showing all the working details of an airplane would be just the thing for our readers. I mean really complete model drawings showing all the controls, instrument board, the fuselage construction, just as on the big machine, the ribs and all the rest of it. These models would be very educational and much more interesting than the usual flying models or solid replicas.

You're quite right, A. A. S., about the educational and interesting features of the models, but I doubt whether many would have the patience or the mechanical skill to complete such a job. There are an almost unbelievable number of small parts in an airplane, and to correctly duplicate them would be a job calling for several years' work.

* * *

SINCE THIS $700 airplane idea was started by the Department of Commerce, the engine inventors are crawling out of their nests in swarms. All of them hope to have their engine adopted in the new lightplane revival and see brighter days ahead. By actual count, fourteen of the Chicago Chapter of Lightplane Engine Builders have called us up by phone.

* * *

ABOUT THREE times every week, visitors to our office ask a well worn question. "If parachutes are declared necessary for small planes, why aren't they necessary for the passengers in large transport ships?" We proclaim the fact that we do not know the answer. Why?

* * *

WE HAVE heard rumors of a new gasoline, now under development, that has at least one very valuable property. It will not burn nor explode except within the cylinders of the engine! If this turns out to be a success, it will be one of the greatest advances ever made in aviation because it will end the present fire hazard, one of the greatest hazards in aviation.

* * *

AND NOW I'm back to the subject of airplane photos. Recently, we have had a number of requests from our readers, asking that we show occasional full-page wartime planes on the back cover. Just as an experiment along these lines, we published a photo of the old Bristol Fighter in the February issue. How did you like it? Are you in favor of more wartime ships?

* * *

A VISITOR at my home, the other day, was looking over my stock of pre-war plane photographs and made a good suggestion. Sezze, "Why not publish instructions for building a model of the Lincoln Beachy pusher—that sure would make an interesting model." I was struck with the idea, but then, alas, knew that a model of this kind called for a whole lot of work. All of the parts are exposed to view and this would be about three times as much work as building a fuselage model. However, if this idea pulls enough votes, it will go over.

* * *

AT TIMES, we have thought that a new magazine should be started, called the "Dinky", which could be entirely devoted to the well known type of Dinky poetry. Of late, the Dinky poems have showered in on us, and we take pleasure in exhibiting a very few examples of this insidious disease.

Here is 33 1/3 per cent of the contribution by W. T. Folesky, Dickson City, Pa. 'Tis brief but to the point.

Bad mechanic,
Dirty plugs,
Engine ran—
Terrible chugs.

That one was easy to take. Next is a real uplifting dink. It was written, composed and submitted by Ben F. Palmer, Sandstone, Minn., who is viewing aviation through rose colored glasses.

Depression over,
United States,
Aviation prospers,
Officials state.

Then comes a long long one—too long for this space—so we'll only exhibit the last sad verse. Author—Paul Weber, 7818 New St., Wyndmoor, Chestnut Hill, Pa.:

His License
Jerked away,
Bum pilot
Raises hay.

This back-to-the-farm movement, as it would seem from the first part of the poem, was induced by a flat-spin and a hard boiled inspector who subsequently gritted, "Gimme that license."

* * *

YOU PROBABLY remember that the first four data sheets were all printed on one side of the page? Well, as this later proved to be against the Post-Office regulations, the subsequent issue had only two sheets per page but not on opposite sides of the page.

When the second change was made, about forty 'leven readers protested, saying that this arrangement cut up too much of the issue (2 pages) and

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that it destroyed interesting material that might be on the opposite side of the page. They suggested that the sheets be printed back-to-back on the same sheet. So, always agreeable to suggestions—this was done.

But the last few mails are carrying a volley of protests against this third arrangement as it upsets many of the notebooks. So, in this issue, you will find another readjustment which will be continued until we get further advice.

* * *

JUST AS WE go to press, the U. S. Army Air Corps have started in as mail carriers. Between the letter carrying and the C. C. C. details, I wonder how much of our Air Corps is left for defense?

* * *

BEG YOUR PARDON. The bomber shown in the bombing article of last issue, is not a Breguet bomber as noted, but is a Salmson. This mistake should be obvious to the Photo Phans because of the circular form of the engine cowl that accommodates the radial engine.

* * *

A. F. CUTTEN, N. Y., America, writes in telling us of his interest in the Practical Lessons in Aviation. He says, "The Practical Lessons are of great assistance while I am taking physics." Gosh, we didn't know that they acted that way!

* * *

I ALSO WONDER what is going to become of our magnificent airlines of which we have been so proud? Politics has practically ruined the railroads, sunk our Merchant Marine and now are polishing off the air transport.

* * *

HOWEVER, we will see what happens.

—J. B. R.

Orville Wright
(*Continued from page* 224)

could, if he would, be one of the world's leading aeronautical consultants.

The many conflicting and frivolous emotions described and hinted at in the beginning of this piece were gone. I felt something of the curtain of the past unroll before my eyes. We had double-parked in a bustling downtown street to finish our conversation. I think Mr. Wright was in something of the same mood. He, too, seemed to be looking over his shoulder but seeing with the eyes of actual experience what was destined for only a chosen group to see:—the scene of that first day of flight.

Perhaps he had some difficulty in bringing his mind back to the duties and rountine of the day. I did.

END.

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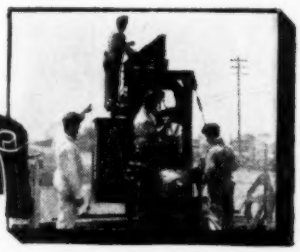

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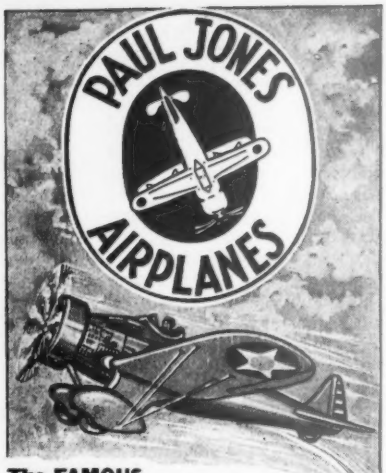

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Practical Lessons

(*Continued from page* 236)

force (R), the latter force being the combined effect of the lift and drag. For example, if the plane balances about the center of pressure (O) with the given lift and drag shown, then the corresponding resultant force (R) can be used to replace the two original forces if applied at the angle indicated. As before, the position of the center of pressure (O) changes with each change in the angle of attack and the relative values of (L) and (D) also change.

In the above description, we have opened up another subject. That is, the relation of the lift and the drag. This ratio, known as the "lift-drag ratio" or the "L/D," is the measure of the wing's effectiveness (not efficiency) and the objective of all experimenters is to create a lifting surface having the greatest possible lift-drag ratio. To have a large lift-drag means that we are supporting a great deal of weight with only a small drag, hence the power consumption will be correspondingly reduced. With a flat plate as shown up to this point, the lift-drag ratio is comparatively small—in the nature of 4.0 or 6.0—while the lift-drag of modern wings is over 20.0 in nearly all cases and as high as 32.0 in a few isolated examples.

Thus, when a wing has an L/D of 20.0, one pound of drag overcome by the propeller will lift 20 pounds of weight. With the flat plane, the load lifted will be only in the nature of 6.0 pounds per pound of propeller thrust. This is the reason why flat wings are not adapted for the main lifting surfaces of airplanes although they are very commonly employed as tail group surfaces for reasons that will be explained later.

So, the early experimenters found that flight with flat surfaces was an impossibility and it was not until a further investigation into the form of birds' wings was made that results were obtained. As a matter of fact, flat wings could not raise the weight of a modern light engine at all, let alone lifting the pay load, airplane structure and the rest of the machine.

A research into bird wing construction by Moulliard, Lilienthal and others, disclosed the fact that the bird wings were arched in form, that is, they were concave on the lower surface, convex on the top surface, and thickest where the wing entered or cut through the air. This, of course, led to the present form of arched wing section by varying methods.

It was not so much that flat plates lacked a certain amount of lifting capacity, but that the drag was so great that the flat plate could not be pulled through the air at high enough speed to obtain lift. It was based on this fact that the French scientist declared that "mechanical flight would not be possible until seventeen swallows were as strong as one horse."

The next step in the development of the wing was the curved plate of Fig. 4, which is variously known as a cambered or arched surface or as an "airfoil." As a rule, the best airfoils are most deeply arched at a point about one-third back from the leading edge (e) as measured from the straight "chord line" (e-t) drawn across the leading and trailing edges. The camber is measured at (d).

As will be seen, the arched plate accomodates itself more closely to the airflow and with less turbulence than the flat plate. The lift is also increased so that the lift-drag ratio is very greatly improved by both causes. While it is an improvement so far as effectiveness goes, it is impracticable as an airplane wing because the plate is very thin and therefore provides no room for adequate structural members such as the wing beams, ribs and other parts of the modern wing.

Various curves have been employed for the cambered plate, circular arcs, parabolic sections, elliptical sections and so forth, all of which have given varying results. In practically all forms, however, the travel of the center of pressure is just the reverse of that with the flat plate. With the cambered plate the center of pressure usually moves forward with an increasing angle of attack while the C. P. of a flat plate moves toward the rear.

At the beginning, airplane constructors attempted to keep as close to the thin cambered plate as possible which led to many structural difficulties. The early Wright wing in Fig. 5 is an example of this period with the front spar or wing-beam (F. S.) at the leading edge while the rear spar was necessarily placed farther ahead than is done at present because of the extreme thinness and flexibility of the wing at the trailing edge (t). Even then, the wing beams were too small for practicability. It is claimed that the lift-drag ratio of this wing was about 10.0 to 12.0. Double covering was applied at the top (T) and bottom (B).

The curved form of the Wright airfoil was maintained by curved top and bottom wood strips, known as "ribs" which were attached to the spars and carried the fabric surfacing. These strips or battens were spaced apart at the required distance by small blocks placed between them so that the section of the airfoil was an approximation to a circular arc.

An arched wing of the single-surface type, used by Curtiss on his early ships, is shown by Fig. 6. The ribs were attached to the tops of the two wing beams, leaving the beams exposed to the air on the lower side, while only one layer of fabric was stretched over the top of the wing. This, while decidedly inefficient because of the exposed spars, was not only employed by Curtiss with success but also by Farman (in modified form), the Voisin Brothers and others.

END.

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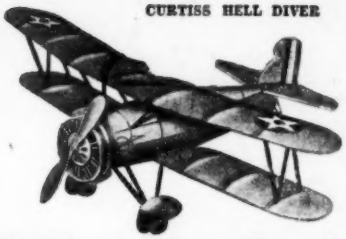
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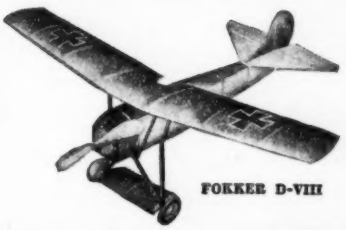
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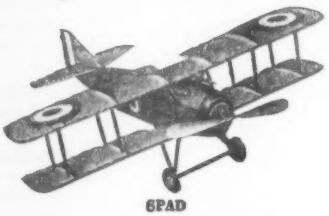
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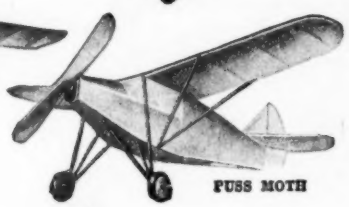
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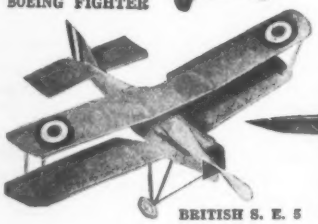
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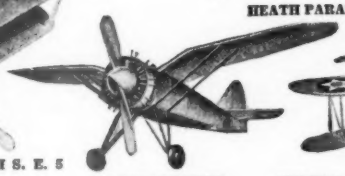
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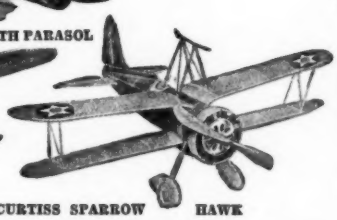
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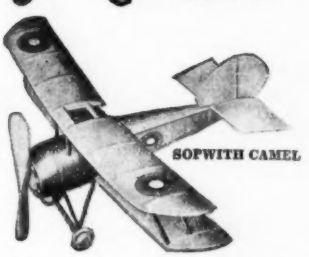
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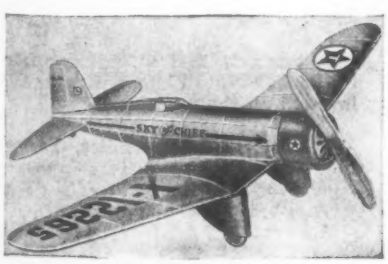
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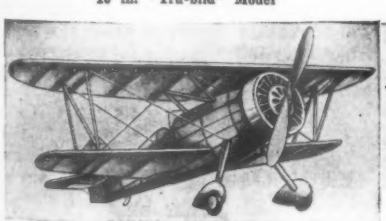
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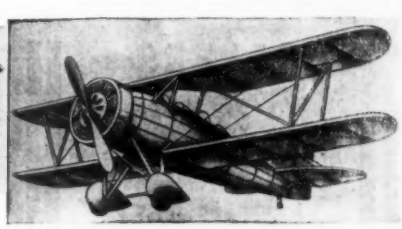
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Liberty

(*Continued from page 239*)

It was planned at first to make three different types of Liberty—sixes, eights and twelves. It was soon found, However, that for wartime purposes anything less than a twelve-cylinder motor would be as good as useless. So the sixes and eights were practically forgotten.

The 12-Vees were built on the Rolls Royce idea—each cylinder a steel inner shell with pressed steel jackets welded on the outside. Six cylinders to the bank, they were secured to the crank case in such a manner that each was allowed full expansion in each direction.

The banks had an included angle of 45 degrees. An unusually acute angle, this, when one considers that most Vees are angled at 60 or 90 degrees. But the idea in the Liberty was to make the engine more compact and accordingly stronger; to strengthen the crankcase; to reduce air resistance and to save width. The overhead valve action unit ran the entire length of each bank and was easily removable. The hot juice was supplied by Delco ignition or Dixie magnetos and the cold juice was distributed through two duplex Zenith carbureters, located in the Vee of the engine. The valves were operated by overhead camshafts with the cams enclosed exactly like those on the Hall-Scott engine.

But all of this was sixteen years ago. The old Liberty has stood the strain well, but now she's wearing out rapidly. No longer does the Chief of the Air Corps deem it economical to repair the Liberties that are still in service; so a few days ago, a War Department order was published proscribing further major overhauls or expensive repairs. So officially, the Liberty is dead—but there are thousands of farmers, campers and fishermen who are still finding their Liberties quite practicable in the operation of lighting plants, sawmills, motor boats and other installations.

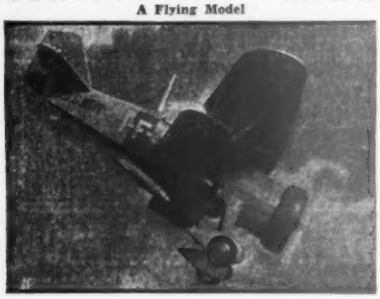
The last one to be pulled from the lumbering observation ship she's now hauling around through the skies, will find a permanent resting place, along with her "service record" and honorable discharge, atop a pedestal that has already been prepared and reserved for her in the interesting and unique museum of the Army Air Corps at Wright Field, Dayton, Ohio.

And this, we predict, will take place just about the time this story appears in print.

END.

CURTISS NAVY HAWK

A Flying Model



Span 22⅝". Length 16⅝"
Three-quarter inch scale

The first accurate scale model of this newest Navy Pursuit ship—and what a marvelous model it is with many features and details new to model planes! Dummy balsa bombs; removable auxiliary gas tank; clever, "half pants"; wheels with no visible hubs; detailed Wright motor complete to the radio shielding on the ignition wires; accurate scale prop; radio mast; ingenious dash with instruments covered with celluloid; crash padding just like real plane; dummy throttle and even a fire extinguisher.
All these authentic details are accurately shown on the new super plans that Peerless includes in these wonderful kits. You make them yourself and you'll agree that with such drawings you can do things not previously attempted in model building.
Large picture shows the plane diving on an imaginary enemy and dropping its bombs before engaging in actual combat.

This kit contains Peerless Balsa, all flat wood clearly printed in the three different thicknesses of ⅛", 1/16" and 1/32". FIVE bottles of those marvelous Peerless Dopes in Navy Grey, Marine Yellow, Red, Black and Silver. Material also included for motor cowl made in a "great" new way, gas tank, bombs, etc., and more than enough evenly cut, smooth balsa strips. Wheels are turned wood. All insignias are printed in their correct colors, size and shapes. With such a kit you have enough material to build this wonder ship according to the detailed plans that come with it. Price, postpaid.. **$2.75**
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20" BOEING P-12-E

Photograph of the Boeing P-12-E Model

ITS HERE: A Super Detailed True Scale Ornamental Model of the famous BOEING P-12-E. You will be amazed at the striking beauty and detail of this distinctive model. Note the corrugated control surfaces, wing walks, naturalistic engine cowlings, even the ignition wires.
This model is available in carefully constructed Finished Form. And in form of an unusually large and most complete Construction Kit, easy to build up. The kit contains all the necessary material, plenty of dope, cement, lacquer, balsa wood, bamboo, wheels, etc. Also lots of miscellaneous material that goes to make up the detail. Together with a full size Three View Drawing, Pattern Layout and Instructions. The price of this large kit is only $4.75 complete. Postage 30c extra. Send 10c for photo and price of finished models. Descriptive folders 5c.

VICTOR STANZEL
High Grade Model Aircraft
SCHULENBURG, TEXAS

Q & A

(*Continued from page 240*)

QUESTION:—*Why is spruce so commonly used in airplane construction? I should think that oak would be stronger so that the parts could be made stronger and lighter.*

Answer:—STRENGTH for strength spruce is the lightest wood practicable for airplane construction. Oak is stronger per square inch but it is heavier for a given strength. Ash is much used but it is likely to warp or curl up when moist unless very well protected by water-proofing compounds.

* * *

QUESTION:—A. A. Eckles, Minneapolis, Minn. *What is meant by the term: "Modulus of Elasticity?"*

Answer:—THE modulus of elasticity is the ratio of the stress in a material to the strain. In this phraseology, "stress" is the load acting per square inch while "strain" is the amount by which this load deforms the material and is given in terms of stretch per inch of length. Thus, the modulus of elasticity of spruce is 1,310,000. The modulus of almost any class of steel is approximately 29,000,000.

This is true only up to the elastic limit, or up to the point where the deformation is in direct proportion to the stress. Above the elastic limit, the material stretches faster and does not completely return to its original form.

* * *

QUESTION:—G. T. Thomas, Springfield, Mass. *What type of plane did Falconi use when in the United States last summer? Please print a picture of it.*

Answer:—FALCONI used a Caproni plane, specially built for stunting and for flying upside down. The picture of this ship appears at the head of this department. It was with this ship that Falconi flew from St. Louis, Mo., to Chicago with the ship inverted all the way.

* * *

QUESTION:—K. R. Philips, Youngstown, Ohio. *Why are there an uneven number of cylinders on a radial engine when others have even numbers?*

Answer:—EACH cylinder must fire once in two revolutions of the crankshaft, and as there is only one crank in the typical radial engine, this requires alternate firing of the cylinders in the following order:

5 CYLS. 1-3-5-2-4.
7 CYLS. 1-3-5-7-2-6.
9 CYLS. 1-3-5-7-9-2-4-6-8.

* * *

QUESTION:—Frank Metz, Baltimore, Md. *Which wing of a biplane carries the greatest part of the load?*

Answer:—THE upper wing carries the greater part of the load under normal flight conditions. The down swept air from the upper wing interferes with the lower wing.

END.

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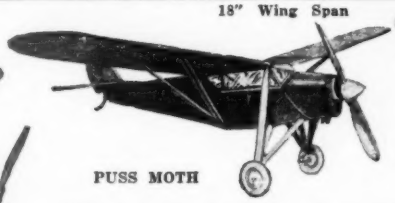

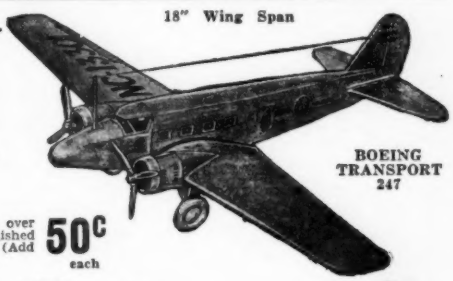

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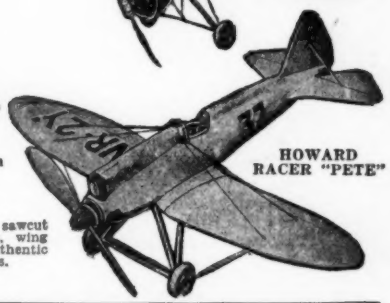

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T-2003

(*Continued from page 220*)

class. It's the individuals among both classes, who vary and who must be studied *as individuals* in order to give them the best instruction."

"YOU haven't interviewed any medicos on the subject," suggested the lad who criticizes my writings. "Maybe they have a different slant, examining so many prospective students of all ages."

Great idea. A smart boy. Straightway to an examining surgeon and I was fortunate in finding one who had made a hobby of studying the middle-aged man as flying material—and who was finally prevailed upon to talk, although he asked that his name be not mentioned.

"Normal vision and sense of equilibrium," said he, "are necessary for a pilot. The dangers of vertigo, or faulty equilibrium, are so apparent that I need not stress them. However, normal equilibrium, once possessed, will remain normal unless some disease may destroy that function, such as exceptionally high or low blood pressure, diabetes, Bright's disease, or the like. In other words, the sense of equilibrium is not lost as a person grows older, provided he keeps his health.

"Vision does change with age. As the years go by, the lenses of a person's eyes grow less elastic. They cannot respond quickly or at all to changes in focusing on an object. That is called the "power of accommodation." If a man has normal vision in youth, that change usually occurs at about 45 years of age.

"Let's watch the fifty year old student come in to land. As he nears the ground he looks ahead at the nose of his plane and the horizon, then down at the leading edge of the lower wing, or the edge of the cabin window, and, further on, at the ground. It is difficult for him to accommodate his eyes to the sudden changes in focus. Hence the older man has trouble in landing.

"Vision can be corrected, to a certain extent, by glasses, but this is not always satisfactory. I would not advise a person in his fifties to learn to solo the *average* present day airplane, unless other compensating factors were present; such as exceptional ability at coordination of hands, feet and mind, which is so essential to good piloting.

"At the same time, I certainly would not say that the experienced pilot is all washed up when he reaches the age of 50 years or so. I am speaking of the prospective student, in terms of the average present day airplane and the average man.

"In several cases where newspaper reports told of some sixty year old man getting his pilot's license I became interested, but found upon investigation that one or more of the following factors were present:

1. He had learned to fly years ago and was just now applying for his license.

2. He already had a license for which he could have qualified years ago and was just now getting it raised, let us say, from a private to an L. C. or transport grade.

3. He was using an exceptional airplane, with a landing speed of less than 35 miles an hour.

4. He was an exceptional man.

"To sum it all up," concluded the medico, "the biggest hindrance to aviation is the lack of a plane that can really go places and do things, among these things being the ability to land at 30 m.p.h., or slower. Can you imagine the number of elderly auto drivers you'd have if you couldn't throttle an auto down to slower than 50 m.p.h. in traffic?

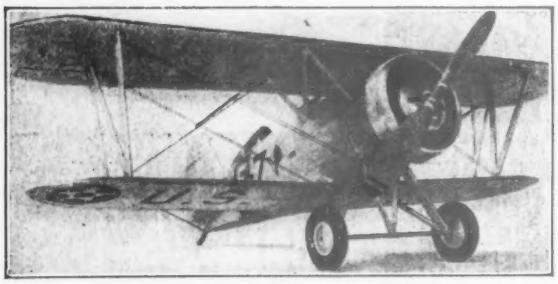
Well, it's the same thing with the plane—only worse, for the plane is moving in two directions at once.

"The next greatest hindrance is not in the slogan 'Flying is a young man's game,' but in neglecting to add—'but a middle-aged man's delightfully interesting, healthful, and absorbing hobby.' Games can get awful dull, but hobbies—never."

A smart medico this—*he* learned to fly at 48.

END.

BOEING F4B4 PURSUIT



22½" Span. Weight 2¼" oz. Flies 750 Feet

A special detailed model of Boeings latest pursuit. Construction Set includes fuselage formers, ribs printed on balsa, wing, fuselage, and Army insignia, printed instrument board, celluloid wheels with silver discs, silver and yellow dope, glue, drawing, 3" celluloid motor, aluminum motor plate and drag ring, tail wheel, flying wires, ready formed wire parts. Const. Set in colored labeled gift box. Postpaid.....$ 2.95
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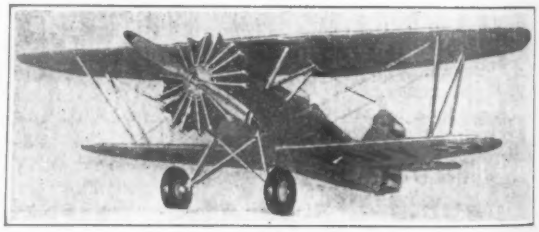
CURTISS SEA HAWK P3A



24" Span. Weight 2 oz. Flies 900 Feet

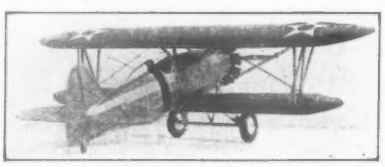
A finely detailed model, practically crashproof. Set includes 3¾" exact scale P & W Hornet celluloid motor, balloon celluloid wheels, printed instrument board, fuselage, wing and rudder insignia, aluminum pilot's seat, dope, glue, drawing and all materials. Special Fibre propeller. Set in labeled gift box. This plane is used by Al Williams, speed flyer, and U. S. Navy. Const. Set Complete, Postpaid.....$ 2.95
MODEL READY TO FLY.....20.00

New Curtiss XP934 Pursuit

24" Span. Weight 1¾ oz. Flies 675 Feet

Set includes semi-finished wheel pants, glistening hollow metal exhaust pipes, strong aluminum wheels, two color dopes, glue, wing and rudder insignia, U. S. Army lettering, detail drawing, ribs, formers, etc., printed on balsa. Const. Set, Postpaid...$1.75

Boeing P12D Fighter



15" Span. Weight 1 oz. Flying Model

Here is a little beauty, with 2" celluloid motor, aluminum motor plate, celluloid wheels, colored dope, all parts printed on balsa. Semi-finished prop, etc. Const. Set Complete, Postpaid.....$1.25

Curtiss Cyclone Swift

18" Span. Weight 1¼ oz. Flying Model

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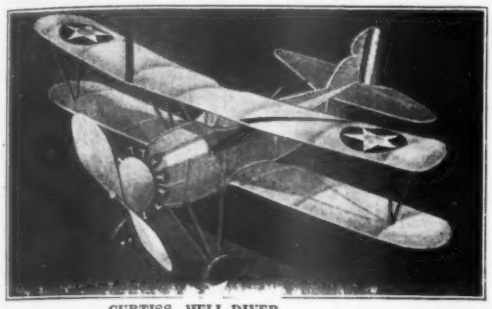

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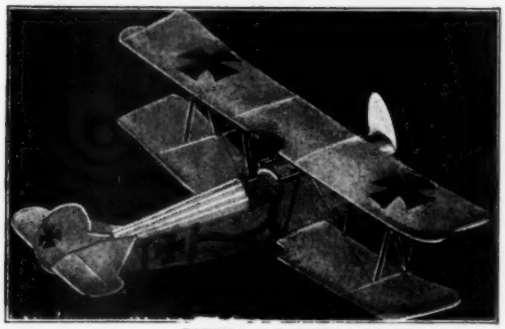

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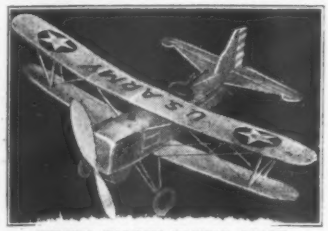

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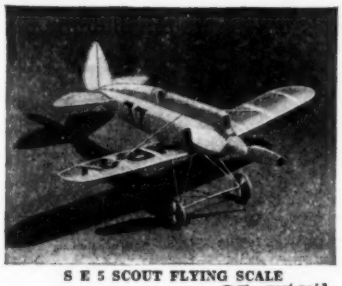

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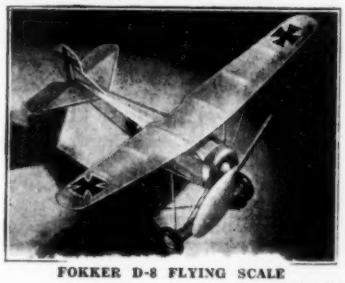

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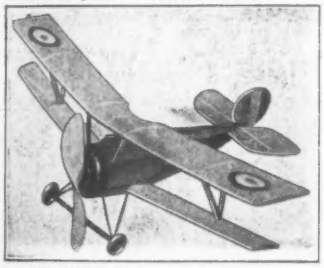

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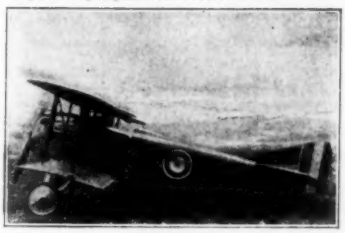

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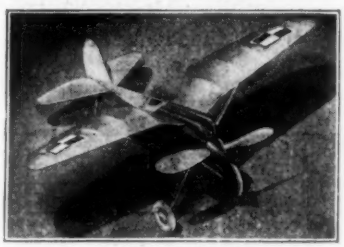

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Jim Healy

(*Continued from page* 218)

Healy sent in a burst and the confident German went down to his doom.

One day one of Healy's flights ran into a 15 enemy plane formation. A terrific dog-fight followed and half of the Germans went down or withdrew. It was a brilliant victory for the Americans, but Healy noticed Lieutenant Stevens' plane going down in a spin. At first he thought the Buffalo lad was spinning his ship as a gesture of rejoicing for their victory. But when Stevens' plane burst into flames Healy knew he had lost his buddy.

Two days later, "The Wolf" took to the air alone to avenge Stevens' death. Flying over the lines at his favorite altitude of 15,000 feet, he saw three Fokkers with the unmistakable markings of the famous Flying Circus, once commanded by the famous Baron von Richthofen. He knew that each one of those enemy pilots was an Ace, for to become a member of the Jagdstaffel a pilot had to have at least five confirmed victories. Willing to pit his skill against the best Germany had to offer, Jim dived after the trio.

It was a grilling one-sided duel. Vickers and Spandau lead sliced the sky. Machine guns yammered. Motors mawed at the air. Bracing wires and struts screamed and moaned as pilots cut intricate acrobatics in the tracer-smoke-filled battle sky. Healy saw one of the Boche pilots clutch at his chest, sink into the cockpit of his Fokker and go down.

Then there was a blinding flash before Jim's eyes. His goggles were shot off his face. Blood rushed into Jim's eyes, blinding him as he put the prop of his ship down in a power dive.

He pulled the Spad out of the dive and the terrific force of the backwash lessened. Jim discovered the bullet had clipped the bridge of his nose. Bleeding freely the rush of wind had forced the blood back into his eyes.

The two Fokkers followed him down. A bullet drilled his radiator, causing the motor to conk. And with a dead motor he was unable to operate his Vickers guns. Wounded, struggling with a conked motor and dead stick, with no possible means of fighting for his life, Healy ruddered a zigzag course earthward.

At 10,000 feet Healy lost consciousness. His plane went off in a nose dive. Down, down it went for a sheer terrifying drop of 9,000 feet. The rush of wind on his face brought him to. Nearer and nearer the plane came down above No Man's Land. The last thing Healy recalls was that in one last desperate effort he pulled the stick all the way back into his stomach. Then he lost consciousness again.

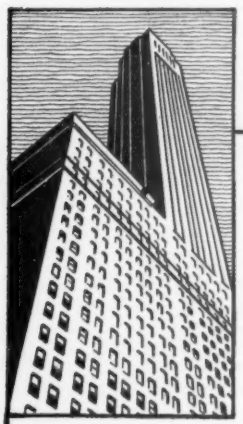
The plane struck the ground behind the American first line and snapped over on its back in a ground loop. Yankee doughboys nearby rushed forward and extracted the unconscious pilot from the wreckage. Jim was sent to an Evacuation Hospital. In less than ten minutes after he had been taken out, the German artillery lined their guns on the wrecked plane and blew it to bits. From the Evacuation Hospital Captain Healy was sent to the Base Hospital at Vitell.

During his convalescence the American soldiers had succeeded in breaking the German advance. They had forced the Huns to relinquish their hold on Chateau Thierry. Squadron 147 was moved to the St. Mihiel sector, occupying an airdrome at Rembercourt.

Anxious to get back in the thick of things, Jim went to the Major of the Medical Corps and requested a discharge from the hospital at once. The major refused. That night Healy bluffed an ambulance driver into putting his trunk on an ambulance and driving him to the railroad station. He returned to the Front. But this time he did not bother to go by the way of Paris.

Captain Healy saw service on the St. Mihiel Front and also on the Argonne-Meuse from Montfaucon to Verdun, during the first and second offensives. The squadron was assigned to low patrol work and a considerable amount of ground strafing.

On September 30, "The Wolf" was flying in a six-plane patrol. Due to motor trouble he was forced to land



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just inside the American lines where he was able to make the necessary repairs.

By the time he could take off, his patrol was nowhere in sight. Healy began patroling the lines alone. Seeing a German Halberstadt taking pictures over Verdun, he immediately went racing towards the ship. A short, stiff fight ensued and Jim shot down the Halberstadt. Before Healy had time to recover he was attacked by two German Fokkers. Of this scrap the Ace said:

"It was more through good luck than skill that I destroyed another one of the Huns and the remainder hi-tailed it away."

And so the lad from New York, New Jersey, and a particular point west—Fort Leavenworth, to be exact, fought his last double battle and won his last two-in-a-day victory.

Captain Healy was decorated with the Distinguished Service Cross, the French Croix de Guerre, the French Cross of a Knight of the Legion of Honor and the Medal of Honor of the Aero Club of America. Five of his many victories were confirmed.

After the armistice Jim Healy was stationed at Washington, D. C., in the Office of the Chief of Staff of the Air Service. There he was Assistant to the Chief of Information Group.

Those were anxious hectic days for 147. Harassed by a superior enemy air force, both in equipment and experience of its personnel; with their buddies being killed off or removed to hospitals, the *esprit de corps* of the organization was remarkable. Each evening as Jim came in to mess there would be an empty chair, mutely telling the story that another of his lads had fallen before the Winged Horde of Hohenzollern.

From 1923 to 1927 he was stationed at Scott Field, Belleville, Illinois. He qualified as "airship pilot" and "airship observer," and instructed students in flying non-rigid ships. In 1927, the War Department directed him to Kelly Field, where he was assigned to the technicalities pertaining to the lighter-than-air portion of the motion picture "Wings," said to be the most perfect picture, technically, of war-time activities.

In 1928 he went back to heavier-than-air flying and took command of 42nd School Squadron at Kelly Field. In the Fall of 1929 he was transferred to the Panama Canal Zone and was stationed at France Field. In 1931 he was appointed Secretary of the Air Corps Primary Flying School at Brook Field, Texas. In October, 1931, he was again placed in command of the 42nd School Squadron at Kelly Field.

And any cadet at Kelly will tell you that "The Wolf," who is now affectionately called "The Skipper," is an "Ace of a man."

END.

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DEPARTMENT OF TECHNOLOGY

Bellanca

(*Continued from page* 230)

is an added safety feature for the reason that it easily clears such objects as boulders, stumps, etc., when landing in a rough field.

This plane, so far as the powerplant is concerned, is built in two units. The first is the airplane unit which is completed up to the firewall. The second unit is the engine mount that is fitted to four connections on the airplane unit. Thus, the power unit is an independent unit which can be detached from the fuselage with the engine, oil tank, oil radiator and with all oil piping in position. This makes engine service work both quick and economical because of the accessibility of all units through the quickly opened and easily detached cowling components.

Two welded aluminum gasoline tanks, easily removable for repair, are mounted in separate wing-bays adjacent to the fuselage. The normal capacity of each tank is 100 gallons—the fuel level being indicated by electric gauges in the pilot's compartment. Two gasoline lines run from each tank to a valve on the instrument board and then as a single line to a wobble pump, through a strainer, to the engine driven gasoline pump and thence to the carbureter. Pipes are taped and clipped to prevent crystallization.

A welded aluminum lubricating oil tank is mounted in the detachable engine section, and before returning to the tank, all of the oil passes through a honeycomb radiator for cooling. The amount of air passing through the radiator is controlled by a flap damper controlled from the pilot's compartment and the oil can be drained off without disturbing the cowling.

The fact that all of the wires are contained within conduit adds to the certainty and safety of the electrical system. The frame is shielded and bonded for radio reception. While the engine is standing, current is supplied by a 35 amperehour battery mounted in a cabinet back of the pilot's seat.

An unusual degree of stability is built into the ship. It flies "hands off," shows no spinning tendencies, stalls with difficulty and automatically recovers from any abnormal position. The adjustment of the horizontal stabilizer is accomplished by means of a handwheel within easy reach. Slot balanced ailerons extend practically the whole length of the outer bay. They are of wood, fabric covered, moving on steel pins in bronze bushings.

Fin, rudder and elevators are built of welded chrome-moly steel tubing, the elevators being mounted upon a common main spar of round tubing. This simplifies the rigging of the elevator control. The stabilizer is of wood construction with a steel screw and a bronze nut applied at the rear end for adjustment. All surfaces are fabric covered while the rudder is of the balanced type.

The nature of the wing bracing makes this part of the construction exceptionally strong and reliable, both in the air and when taxying on the ground. For this sort of service at least, where a low-priced plane is to be employed for transport service, the wood wings, steel tube fuselage and the fabric covering are more practicable than the all-metal construction so popular at the present time.

Just what percentage of the lift is contributed by the lifting struts has not been stated by the builders of the Bellanca, but judging from the area and the inclination of the struts, this must exceed 20 per cent of the total lift.

Every provision is made for the pilot's comfort, excellent visibility, comfortable upholstered seats, roll down windows in doors at each side and a well placed throw-over column. The automobile type wheel makes elevator control and aileron movement comparatively effortless. Automobile type heavily padded dual pedals give free movement to the balanced rudder.

END.

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We have the following books for sale at reduced prices. Send us your order subject to prior sale.

Sky Larking.....Bruce Gold
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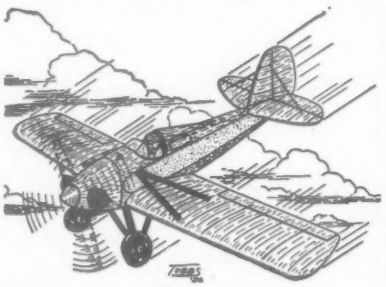
Announcing Here you are boys! What readers asked SPORTSMAN AVIATION to give them is now ready. Just what you, too, have been waiting for. A real true honest-to-goodness lightplane of good design, simplicity and low-cost. Our S-A "Moth!" A low-wing which every amateur will dream about. Powered with the highly successful LONG 35 h.p. "Harlequin" Twin. Can be built for $350 or less. Enclosed cabin optional. Its perfect ballance assures stable flight with utmost safety. And a speed range almost unbelievable.



Specifications:

Span	30 ft.
Chord	4 ft.
Airfoil	Clark Y-15
Length	17 ft. 6 in.
Height	4 ft. 6 in.
Weight empty	350 lbs.
Weight loaded	550 lbs.
High speed	100 m.p.h.
Cruising speed	85 m.p.h.
Landing speed	25 m.p.h.

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Good Opportunities for Our Swappers

The publishers reserve the right to reject any or all notices that are not in accord with the policy of this magazine. Only trades or "swaps" will be permitted. For cash deals, buying or selling, refer to our Buyer's Directory. Readers are urged to use caution in arranging trades and references should be mutually exchanged.

AIRPLANES

WILL TRADE 40 acres of good hardwood cut-over land near Niagara, Wis., easily cleared, good hunting and fishing for Waco or Travelair or similar plane. Must be eligible or licensed. —W. J. Bourdlaies, Box 457, Norway, Mich.

WANTED one 300 H.P. Hisso or good Liberty. What do you want?—W. C. Ingersoll, 803 N. Court St., Ottumwa, Iowa.

HEATH PLANE complete less wings and fuselage covering for 28 or later 2 or 4 cylinder motorcycle.—Stuart Jewell, Bristol, Illinois.

WILL TRADE my new Pietenpol Air Camper, just built, identified, flown one hour in test hop, all complete and A-1 thruout. Flies with hands off controls. Want a 1 or 2 place sportplane with or without motor that is eligible for license. Need not be in good shape, or will trade for garage equipment.—Super Service Station, Saratoga, Iowa.

HEATH PARASOL—Ship ready to fly. Heath converted Henderson in need of overhaul goes with it. Over $300 spent in building. Will trade for light car, or best cash offer. Must sell. Make me an offer.—John Rohn, 703 3rd Ave., Hibbing, Minn.

HAVE welded steel tubing fuselage built after Corben baby one plans complete with landing gear, wheels, and materials for shock struts. Also wings uncovered and Heath tail surfaces, extra tubing to finish struts, etc., one gal. dope, 100 yds. 2 in. pinked tape, altimeter, magneto switch, balsa wood for streamlining, turnbuckles and aircraft wire. Also have helmet and goggles, flying suit, log books and books on flying both fiction and practical. Would like a two or three place ship in flying shape, does not have to be in A-1 shape, or what have you?—Warren R. Stapleford, Goodman, Wis.

1928 STD. BUICK SEDAN. Good as new. Driven 15,000 miles. Will trade for licensable lightplane. 2 place preferred. Parasol type preferred but no reasonable offer refused.—Cecil Wicks, Sandpoint, Idaho.

GENET 88, less mags and oil pump, only 50 hours. Will sell or trade for two good Harlequins complete with props.—Lawrence Skont, Marshall Airport, Marshall, Mo.

LINCOLN Sport biplane; single seater, brand new; never flown, powered with 3 cylinder Anzani, new Hartzel prop. Photo 5c. Will trade for any of the following two place ships, Arrow Sport preferred; parachutes, motorcycle, two cylinder aircraft motor, typewriter or anything else I can use. Will take or give cash as warranted.—Glenn Strauss, 818 Lincoln Ave., Toledo, Ohio.

HARLEY Davidson Motorcycles. All models to trade for light aircraft engines or planes. Or will pay you spot cash for your engine or ship. Also good buys in used Harley Davidson late models. Good used Harley parts reasonable. Let me know your wants.—L. J. Perry, Harley-Davidson Sales, Kalamazoo, Mich.

1931 FORD Victoria Coupe, new air wheels, 22,000 miles. Paint, motor, upholstery, everything absolutely OK. I want a licensed lightplane ready to go.—P. M. Pratt, Idamont Hotel, Rexburg, Idaho.

SAILPLANE—53 foot tapered, strut braced wing. Good workmanship and materials throughout. Good condition, flown only a few times. An excellent performer. Also trailer. Will trade for Indian Scout, Harley, damaged A. T. C. ship or sell cheap.—R. L. Boynton, 2957 Halldale Ave., Los Angeles, Calif.

HAVE garage in good locality on state route, fine business and A-1 equipment. Employ four mechanics. Will trade for Bird or Great Lakes Trainer, or what have you. Must have cash difference. For full information write—5th Avenue Garage, 164 5th Avenue, Moline, Ill.

A CHARGE of two cents per word will now be made for all advertisements entered in the Barter and Exchange columns. Please enclose remittance on this basis when submitting copy.

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'29 AUBURN RDSTR, Light Six as part payment on 1 or 2 place lightplane. State year built, power, terms, etc.—G. G. Talbott, 21 Balto. Blvd., Cottage City, Md.

LINCOLN SPORT Biplane 30 with a Lawrence double-throw crankshaft, 2-cylinder opposed motor, complete. Trade for small car, late motorcycle, or sport monoplane 1 place.—Charles Lindsey, 1875 E. 70th St., Cleveland, Ohio.

HEATH PARASOL complete, also extra propeller and skiis. Want late light car. Full particulars and photo on request.—Spencer Hanks, Box 326, Proctor, Minn.

OX ROBIN complete dismantled fuselage uncovered, without motor. Ok job can easily be licensed. Waco 9 complete dismantled, also Waco 10 parts, Lawrence motor. I will trade anyone or all for a good licensed light one or two-place plane, NB 3, C. W. Jr., Aeronca, Heath Henderson, or what have you?—H. P. Minor, Gainesville, Ga.

TO TRADE Velie Cavalier 2 Place Cabin Monoplane. Can be licensed. Trade for $500 equity new Ford or Chevrolet or 1933 Ford or Chevrolet worth $500.—William H. Lewis, 317 S. Cherry St., Commerce, Okla.

FORD, Szekely, Salmson, Aeronca, Heath or what have you? Trade $80 Cornet with case. Almost new.—Bud Stewberg, R. F. D. 3, Box 455, Seattle, Wash.

WANTED—Heath Parasol, Corben, or Aeronca. What do you want?—Howard Bettis, Sparta, Mich.

I HAVE to trade a Model T Ford car, 5 tube radio, with speaker, 1 tube set, with phones, books on how to build, operate your own wireless station, aviation books, new folding camera, 4 cyl. magneto and others. What have you in a cracked lightplane, lightplane parts or a motorcycle?—Raymond Egan, River Road, R. D. No. 1, Bound Brook, N. J.

BIPLANE GLIDER, 2-place identified, equipped with Goodyear Air Wheels. Flown nominal amount, no crashes, always hangared, condition good. For sale or trade at sacrifice. Must be disposed of quick, reason owner confined another section country.—Sanders Hudson, Jr., 1800 Angier Ave., Durham, N. C.

GLIDER FOR LIGHT MOTOR. Have 38' Mead trainer, licensed. Want Szekeley 45, Continental A40, Aeronca E113A, complete.—Fred Spar row, 26 Coleman St., New London, Conn.

WANTED—Aeronca plane in flying condition. Have Harley Davidson 1931 model motorcycle 45 inch with side car in good condition to trade. —Renzo Flannery, Browntown, Wis.

HEATH PARASOL less motor and wheels, damaged. V type fuselage rebuilt with heavier tubing at front end. Trade for thread-cutting lathe, or woodworking machinery, small planer, etc.—O. R. Aslakson, Sheyenne, N. Dak.

CRACKED 2-P1 Aeronca—wanted in repairable condition—cheap for cash sale.—Jack T. Thomas, 1568 Cherokee Rd., Louisville, Ky.

ENGINES AND ACCESSORIES

WANTED—Motor cowling for LeRhone 80 H.P. State price and condition. Have converted Star motor and radiator to swap or sell, also electro plating generator.—Melvin Saine, Corner 8th and Wabash, Peru, Ind.

WILL TRADE Heath wings and tail-assembly for auto radio.—Elwin Saalfeld, R. F. D. No. 3, Columbus, Nebr.

WANTED, Kelsey printing press, 5 x 8 size preferred, also midget car engine and wheels. What do you want?—Manley Mills, Royston, Ga.

WILL EXCHANGE 8 cyl. Lorrain-Dietrich Aviation Motor, V type, 220 H.P., or 8 cyl. V type, 40 H.P., converted for boat, for a Miller Marine 2 cyl., 10 H.P., Model F2. Also a 3 cycle, 2 cycle, 20 H.P. Barber Marine or a Joe's one-way clutch, for a small size marine pump-closet. Above is not junk, and will furnish pictures with description. What have you to swap?—Z. J. Standish, 321 University Ave., Syracuse, N. Y.

WANTED—a miniature gasoline engine complete ready to run (including prop.) Have many things to swap.—Herbert Weintraub, 340 Second Street, Jersey City, N. J.

TWO 14 x 3 wheels and tires, 1 safety belt. I have the following parts for a Rhon Ranger glider. Automatic release hook, tail assembly and 2 Ailerons (covered). Flying and landing wires, front part of fuselage with seat and controls installed, ½ wing, (damaged, repairable). Metal fittings for other half of wing, rib-jig, steel wire, blue prints and instructions. What have you?—George E. Adams, Moravia, New York.

AIRCRAFT Instruments wanted. Have guns, radio meters, radio parts, magazines, and many other things to trade. Let me know condition of instruments you have.—Burton Wollenzien, 2439 N. 48th St., Milwaukee, Wis.

WANT a Salmson A-D9 motor in good condition and complete. What do you want?—Stanley LaMar, Hagerstown, Indiana.

WANTED—Gasoline motor. What do you want? —Shurig, Ling St., Fords, N. J.

HAVE Woodworking Lathe, want bicycle or motorcycle engine, complete.—William Rhoerig, 1118 Erie St., Utica, N. Y.

GASOLINE ENGINE. What do you want?—H. Sevcik, Jr., 146 Chestnut Ave., Bogota, N. J.

WANT used built-up parts for lightplane such as Heath, Longster, Aeronca, preferably uncovered. Also used Harlequin or converted Ford "A" motor complete or in part; or other 30 to 50 H.P. lightplane motor. I have a fully paid complete but unused scholarship with Federal School of Commercial Art which will arrange to transfer title, etc. Also have used but complete Langdon Cartooning Course. Give full details of what you have and what you need.—J. G. Parrott, Box 1915, Phoenix, Arizona.

FOR TRADE—Good OX5 or Hisso motors or parts, or special Hisso Pup motor, for sheet dural, aluminum, or what have you. Correspond with—U. S. Aircraft Engineering School, 1732 Grand Avenue, Kansas City, Missouri.

WANT 45-55 H.P. good lightplane motor complete. Will trade my Heath Henderson and Heath wheels complete, plus cash. Motor is in excellent condition (winds 3200).—Aldo Ambrosini, 2304 E. Butler St., Chicago Heights, Ill.

FOR SALE—International Biplane parts, good shape. Some OX5 parts, also hound dogs and pups. Useful products for homes. Will trade in for airplane.—E. L. Mack, Montrose, Pa.

WANTED TO TRADE a Ford motored Air Camper on a two-place licensed monoplane,

high wing preferred. State particulars first letter. What have you?—Homer Wolverton, R. R. 2, Montpelier, Ind.

LIGHTPLANE ENGINES WANTED. Continental A-40, Salmson A-D-9, Szekely, Anzani preferred—will consider others. Have new Single-place MEAD KIYAK worth $27.50 and two new Primary Gliders worth $625. What have you, and what do you need?—Hicks Aircraft Company, Fillmore, Ill.

LIGHT CAR or motorcycle with side car wanted. Have aircraft parts, OX5 parts, Aero correspondence course, etc., to offer in trade.—Ostergaard Aircraft, Parr, Indiana.

MISCELLANEOUS

1927 WHIPPET-FOUR parts to trade. Want two-tube short wave radio, or what have you?—Wm. McGillis, Farmdale, Ohio.

MOTORCYCLE WANTED, running. Harley preferred. Will swap mechanical mags, Smith motorwheel, etc. What else have you? What do you want?—Alfred Withrow, P. O. Box 416, Teague, Texas.

BRAND NEW 1934 Harley-Davidson single motorcycle in exchange for 1815 or 1822 five dollar gold pieces. No other trades, or what do you want?—Frank Meyka, Plandome, New York.

AVIATION COURSE, Dayton School, 60 lessons, cost $50, and Chevrolet coach model 1927, will trade for a motorcycle in good condition, or what have you? Will trade lessons and Chevrolet separately if wanted.—Alvin Jensen, R. R. 3, Albert Lea, Minnesota.

WILL TRADE 12 gauge Remington pump with leather case, .38 Army Colt, good guitar and $8.00 for motorcycle in fine shape.—R. Howell, Pleasanton, Calif.

WILL TRADE good trombone in case for good used light car and another trombone in case for a circular type ballid horn, and a duplex tenor drum for a good 1933 Philco 7 tube radio.—P. P. Crowder, Bethany, Ill.

HAVE $40 Bicycle with cyclometer; Number 8 Erector Set; and Office Model typewriter. Want F:4.5 Graflex; Leica; Kodak Pupille; or Memo Camera. Give complete information first letter. Will give one or more of my articles in proportion to value of camera.—Edwin Biscow, 336 Central Park West, Apt. 15F, New York, New York.

WILL TRADE .38 cal. old model Colt, 7½ inch barrel, engraved cycl. dated May 1848, altered to breech loader with nearly new reloading tools in good shooting condition, value $20. Also 3040 Krog. 30 inch barrel in very good condition; value $8.00, complete automobile school home-study course, cost me $75. Wanted automatic 22, 99 Savage, 54 Winchester or Rem automatic shot guns and other rifles considered, also double reed accordion. What have you? State condition. Will give reference.—A. C. Monroe, Manistique, Mich.

WANTED a small Victorola. Have blank gun, skis, bicycle, etc. to swap for it.—Frank Whitesell, 146 Brewster Road, Scarsdale, N. Y.

HAVE NEW .22 Special Winchester, 30-40 Krag Carbine in excellent condition, set of Edw. Barntraeger midget auto plans, and one Curtiss Wright text book, Principles of Aviation. Want .45 Colt automatic, gov't, model, or .38 S & W or Colt Police Model, or 9 m/m Luger. Must be first class or new. Or what have you?—M. H. Chilcote, 3 Military Way, Palo Alto, Calif.

PLANS—Primary Glider, Henderson Parasol, Model Plans, books—A. B. C. of Flight, The Lightplane, Modern Aircraft, Dope formulas, Aviation Engineering Mags. Want June, 1929, National Geographic. Send your lists.—Clarence Stein, Kutztown, Pa., R. No. 3.

I AM honest ambitious and will work hard, in exchange for Aviation training leading to mechanics or pilots licenses.—Herman Mechelke, Wallkill, Ulster Co., N. Y.

YOUNG MAN of 20, very much interested in aviation for the past ten years, would like very much to get started in the game by parachute jumping or anything to get out of this town. Will even crack up planes if you teach me how to fly them. Will gladly exchange my labor for any of the above suggestions or anything you can use me for.—B. Fisher, Jr., 1348 Capit ! Ave., Des Moines, Iowa.

YOUNG MAN 20 will exchange work, parachute jumping or any other stunt for flying instruction, mechanically inclined, will go anywhere. —M. F. Ruza, Shreve, Ohio.

YOUNG MAN 19 years old will fly two years for $30 a month and board for anyone who will finance me through a commercial pilot's course. Write—Engelbert Miles, Route 2, Box 82, Hattieville, Ark.

YOUNG MAN will exchange work for mechanic or flying course. High school graduate. Had some mechanical experience. Age 20.—Herman Harder, Bennington, Kans.

LICENSED MECHANIC will build lightplane or rebuild crackup for half share.—Ray Duffy, C. C. C., Taylor, Texas.

SUSPENSION GLIDER. High lift monoplane. Practical positive control system. Lands 12 m.p.h. Material cost $12. Easy to build. Detailed drawings $1.50, or what have you?—Harold W. Huber, R. F. D. No. 1, Willowstreet, Pennsylvania.

WILL SWAP—Air, Western and Detective story magazines for 'Shadow' Magazines, etc.—Henry Cohen, 700 Blaine Ave., Elkhart, Indiana.

WILL GIVE collections of war relics, French and German bayonets, medals, books, photos, airplane telescopic sights and war souvenirs for good parachute or any other aviation articles.—Carl Pugliese, 747 East 168th Street, Bronx, New York.

YOUNG MAN, 20, will do any kind of work around airport to get mechanics license, or small pay.—Douglas Perry, 118 N. Main, Louisburg, North Carolina.

TRADE—Hundreds of perfect back issues of aviation magazines for amateur short-wave transmitter tubes or parts, in good condition. Complete files: Aerial Age, 1916-23; Aviation, 1916-21 and 1927-31; Aero Digest, 1923-31; U. S. Air Service, 1927-29; Popular Aviation, 1927-33; Aviation Engineering, 1928-30; National Glider, 1930-31; Model Airplane, 1931-32. Also several books and lots of German and British aviation magazines to trade. What have you?—Carl Fastje, Denison, Iowa.

WANT TO HEAR from anyone within a radius of 200 miles who has certain (complete) copies of Popular Aviation, Aero Digest, other magazines on aviation. Also interested in airplane photos, exact scale drawings of planes, books, manuals. Everything must be complete. Give complete, accurate list first letter. What do you want?—Lester Sandvik, Bristol, S. Dak.

WANTED—Airmail letters mailed at dedication of new airports. What have you?—Theo. Light, 1216 W. 63rd St., Chicago, Ill.

WILL TRADE—110 aviation pictures mounted on loose-leaf notebook paper with cover. 100 aviation pictures unmounted. Have complete catalog of 600 prints 7½ x 9½. Will trade for aviation courses, or what have you?—Ted Wilson, Box 123, Lake Forest, Illinois.

MAGAZINES, 4 Aviation, 4 Air Fiction, 5 New Yorkers, 1 Hunting and Fishing, 10 Open Road for Boys, 12 successive Boys Life. Also 1 game board (12 games). Will trade for airplane photos.—Robert Wilson, Elm St., North Grafton, Massachusetts.

PICTURES—All modern race and commercial airplanes. Send three cent stamp for list. What have you?—John Cogan, 628 East 15th, Davenport, Iowa.

ARE YOU BUILDING? I have Monocoupe ailerons for thirty foot Clark wings, gas tanks, wing struts. Send stamp for list. What have you?—Anthony Cogan, 628 East Fifteenth, Davenport, Iowa.

WANTED—Glider books, magazines, information of all kind. Watch to swap.—A. Jones, Schertz, Texas.

BLUE PRINTS complete for Crawford monoplane—many parts. What have you? Enclose stamp.—Bill Ritler, Box 150, Davernport, Iowa.

MONOCOUPE, Travelair, Velie parts. Will trade for typewriter, welding outfit, electric drill. Send stamp.—Paul Bloom, Davenport, Iowa.

HAVE 70 Geographic Surveys, 12 scientific fictions, 20 assorted magazines, also International Encyclopedia, camera, telescopic French tripod, new heavy dier bow with dozen arrows; some cash boot. Want last 36 consecutive issues of Popular Aviation, Aero Digest, Popular Science, Scientific American and aviation textbooks, also Kleiser, Cody, etc. English courses, textbooks, and magazines on writing, journalism, latest Ency. Brit., Funk and Wagnalls unabridged dictionary, Rem. portable with standard keyboard, also Jowett course, last 5 years Strength & Phys Cult, magazines.—Des Cannon, 1548 Hotel Place, Cuyahoga Falls, Ohio.

WANTED—Cockburn Lange world war photographs, also real war place relics. Will trade flying model plans and magazines.—Lutz Flynn, 2272 Fifth Ave., Youngstown, Ohio.

ATLAS SHOE SKATES, size 6 shoe. Would like larger size ice skates or what have you?—Edward Aldin, 312 Powhatton Ave., Lester, Pennsylvania.

WANT to hear from anyone, preferably within a radius of 200 miles who has certain complete copies of P. A., Aero Digest, other magazines on aviation, books, manuals, plans of planes, airplane photos, clippings, exact scale drawings, preferably Cessna and Bird planes. Everything must be complete. Have 4½ foot Mohauk Pinto, plans, drawings, other things.—Lester Sandvik, Bristol, S. Dak.

WILL WORK anywhere in U. S. in exchange for a mechanics course (airplane and engine). Twenty-one years old. Have had a year of night school in airplane structure and airplane engines.—Frank C. Powers, 5 Meadow St., Salem, Mass.

TYPEWRITER WANTED. Will trade (30) thirty radio tubes in excellent condition. R. C. A., Cunningham, Philco. Send for list.—Daniel Vasilas, 2102 Ocean Avenue, Brooklyn, New York.

SOLID MODELS, wanted ready built. Will trade 24 inch plans. Curtiss Hawk, Boeing, also Western Flying magazines.—Carl P. Clement, 136 N. L Street, Tulare, Calif.

MOTION PICTURE Screen, with genuine ground glass finish for trade. What have you?—Jack Moss, 303 W. 74th St., New York, N. Y.

WANTED—Primary Glider plans. What do you want?—Lee Baumgarner, 101 4th Avenue, Huntington, W. Va.

WILL SWAP real World War observation front-line views preferably for compressed air or gas motors for models. What else have you?—Spencer L. Bellinger, 314 College Avenue, Ithaca, N. Y.

FLIGHT INSTRUCTION. I'm willing to give flying instructions or solo time in exchange for Ford racer or something similar.—Edwin Levey, 88-46 199 St., Hollis, L. I., New York City.

MOTORCYCLES — AUTOMOBILES

SWAP new E. C. 2 high-wing side by side dual control monoplane, needs Kinner K5 motor, for late model motorcycle.—Dick Slocum, 48 Wardman Road, Kenmore, N. Y.

HAVE twin motorcycle engine and trans. for a bike with bikemotor or bike. Smith preferred. —Ray Spiker, 3033 E. Baltimore St., Baltimore, Maryland.

LINCOLN SPORT BIPLANE. Good flying condition, less engine. Will trade for late Indian motorcycle.—Wayne Winters, 31 Park Circle, Council Bluffs, Iowa.

FORD MODEL "A," any year, or motorcycle, with side car wanted. Have any kind of airplane parts to offer in trade.—Brauner Ostergaard, Parr, Indiana.

DIRT TRACK RACER WANTED—any condition. Will trade a 1924 Harley motorcycle in excellent condition.—George N. Elliott, Box 303, Arlington Heights, Ill.

MOTORCYCLE WANTED. Will exchange a Lincoln School Home Study Course. Cost $60, for machine of 1924 or later model in fair running condition.—Oliver C. Kallio, R. 2, Box 99, Ironwood, Michigan.

STEWART WARNER Radio with short wave converter, Model 104. For motorcycle 1929-30 or 31 good condition or lightplane in any condition with motor, preferring Aeronca or Curtiss Wright, Jr., two place.—A. H. Sandy, 751 Jefferson, Memphis, Tenn.

WILL TRADE Heath Parasol (V) complete with Heath-Henderson motor, etc., less fuselage for any 1930 light car in good condition, or will sell parts separately.—James Scimone, 30 N. Portland Ave., Brooklyn, N. Y.

I HAVE one 4 cyl. Chevrolet racer, speed 80 m.p.h., 30 miles to gal.; old copies of Popular Aviation and Popular Science. What have you? —Douglas Perry, 118 N. Maine, Louisburg, North Carolina.

I WANT AN AUSTIN. I have a Henderson four-cylinder motorcycle, an Oldsmobile Coach, a typewriter, or detailed blueprints of two different cottages. The Austin may be in any condition as long as it runs.—Wheeler W. Batdorff, 520 Bingham Ave., Sault Ste. Marie, Michigan.

(*Continued on page 273*)

B & E

Too Late to Classify

(Continued from page 272)

MOTORCYCLE WANTED. Harley-Davidson preferred. Must be in good condition. Will trade cornet (Conn make) in excellent condition, complete with muffler, case, etc. Also picture machine in good condition, hand operated with a few films. Aviation books, etc., with a small amount of cash.—Jack Bailey, 513 North 25th St., Middlesboro, Ky.

MOTORCYCLE ENGINE WANTED. 1 or 2-cylinder in good running condition, or four wheels 16 x 4 in good shape. Have many things to exchange and cash if necessary.—Steve Lanchak, 106 Waller St., Wilkesbarre, Pa.

MOTION PICTURE PROJECTOR WANTED, 35 mm, will trade accurate scale models built to your specifications, or what do you want?—G. Townson, 3850 Hazelhurst Ave., West Toledo, Ohio.

AVIATION COURSE for aircraft supplies and parts, sporting equipment, guns or what have you?—Don M. Copeland, 2298 Priscilla St., St. Paul, Minn.

YOUNG MAN, 20 years old, will fly three years for $25 per month and board, for anyone who will finance me through a commercial pilot's course. Can furnish A-1 references. Write—Leo Gottsponer, Hattiville, Ark.

WANTED. Colt revolver or automatic. Super 0.38 cal. preferred. I have model gas engine, compressed air motor and tank, etc.; plenty of aviation magazines and fiction books, riding boots, field glasses, skates, watches, B & L Camera lens and many other things. What do you want? Give full particulars if you have a gun to swap.—J. D. Menard, 966 So. Water St., New Bedford, Mass.

CLASSIFIED

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Aero-Sportswomen

(Continued from page 228)

copy of the 99'er? I am not much of a flyer yet. (I can imagine my teacher's apoplectic face if he could hear even that qualified statement!) But having finished three hours training I'm thinking, reading, talking and dreaming airplanes and aviation. It's getting to the painful point where my friends don a hunted glassy look when they see me coming and start hunting a rug to hide under. Possibly with the 99'er added to POPULAR AVIATION and *Western Aviation* and all the "ground Flying" I'm able to get at the field, I shall be able to censor my conversation into a 'respectable' variety of topics again."

Lauretta Schimmoler is our most prolific correspondent and is always "good copy."

Phoebe Omlie writes from Washington, D. C., "I trust you will call on me if there is anything that I can do to help you. Co-operation is the one great need of our industry and the sooner we realize it, the better all of us will be." Then of course, Clara Studer, editor of the 99'er is grand help and Fay Gillis' letters from Moscow are a joy.

END.

Control Tower

(Continued from page 228)

from the different airlines using the airport, each has its own wavelengths and frequency. The pilots on the United Airlines report to their home office every 20 minutes and those on the other lines at half hour intervals. The operator in the control tower has a time sheet and records each ship as it reports, both as to time and position, thus he has an exact and constant knowledge of the position of all scheduled ships in the air.

He has a small radio transmitter with a radius of approximately ten miles, which he uses to make his own contacts with the incoming and departing ships. The direction and velocity of the wind is obtained from a constant reading anemometer located on the roof of the Terminal Building and indicating on a dial on the operator's desk.

The control tower on the Chicago Airport, the second to be established on any airport, has been in operation for the past nine months. Pilots and airline officials are unanimous in their approval of its worth and feel that it is only a matter of time until it will become an integral part of the equipment on every commercial field.

END.

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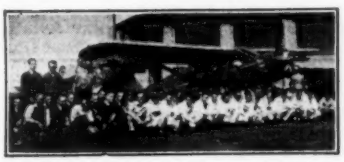

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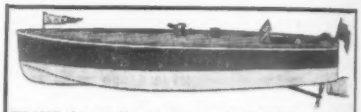

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Propeller

(*Continued from page 243*)

peller is adaptable to standard engine shaft ends as they exist today.

According to Fred Weick, propeller authority of Langley Aeronautical Laboratory, it is possible to obtain higher propeller efficiency by moving the propeller farther forward as done with the Briner-Huntington propeller. It allows more latitude for better and more accurate engine cowling—and hence—better streamlining. Tests indicate that from 3 to 5 per cent higher efficiency is attained by this better propeller position.

By means of a double blade locking feature, due to both the herringbone gears and the 5-inch Acme thread on the outer ball race, it is possible to effectively lock the blade at any desired angle. The hand control line is only a ⅝ inch flexible shaft running to the pilot's cockpit. The propeller is always "in gear" and there are no shifting gears to be thrown in or out of mesh.

The hand-control is provided with a traveling nut with double jaw clutches, the nut moving with the hand crank until the maximum pitch setting is reached. At that point, the jaw clutch stops the movement without jamming, and the same is true at the minimum setting. One degree change in the blade pitch requires four turns of the hand crank in one model and twelve turns in the other. A force on the crank, of from four to seven pounds, does the trick in either case as this load is essentially a friction load. By means of drilled holes, the balls in the intermediate gear housing are lubricated with a mist of oil coming from the engine crankcase.

The weight of the 300 h.p. model complete, including blades weighing 24 pounds each, and complete cockpit control, is 122 pounds. For a Wasp engine, the weight would be about 130 pounds.

A pitch-shift control of the bell-pull type has been designed for the quick reduction of pitch or reversal of pitch by a connection with shaft power. This is supplemental to the manual control and operates with the same pitch indicator. No power is actually required to decrease the pitch while the engine is running because the blade twist or torsion is sufficient for this purpose. It is only necessary to use engine power to keep the pitch setting unlocked continuously until the pitch is reduced to the required extent. This feature is not shown in the accompanying drawings, but is covered by patent.

It is evident from the foregoing, that this multi-pitch propeller is capable of accurate pitch adjustment necessary for any flight condition, take-off, climb, speed, cruising, high altitude operation or running on one engine of a multi-motored ship.

The last, by the way, is becoming of increasing importance on multi-motored transports in cases where one engine cuts out, increasing the demand on the remaining engine or engines, thus requiring pitch readjustment on the active engine.

END.

Building Plane

(*Continued from page 247*)

to obtain. Then, too, the weight of such a structure may be more than that of a tube and fabric job.

Another method of construction that some may wish to use is that which employs dural angles for struts and longerons. The members are used the same way as steel tube, the only difference being the joints. As dural is hard to successfully weld, the use of riveted joints with dural gussets is shown. Members should be slightly heavier than those used for sheet metal construction. This type of construction would be simple and best for the amateur, if it were not for the high cost of such angles. The author can hardly recommend the use of regular angle iron or steel shapes.

In building the fuselage structure for the light ship you should endeavor to keep the weight as low as possible consistent with safety and strength. It is a good idea to keep a safety factor of 8.0 for members which receive sudden or variable stress, and a factor of 4.0 or 5.0 for members that are under constant strains of small magnitude. Weight can be saved by using smaller tubing for the rear half or so of the longerons, than for the heavily stressed front section. Generally the rear half is telescoped into the front section, and the heavier tube has a fishmouth section cut out of it. Here it is welded to the smaller tube, and results in a shear weld, as sketched.

END.

Bellanca

(*Continued from page 256*)

a time. The motor nacelles are covered in very much the same manner. Wing panels are covered in two separate pieces, top and bottom.

After the model has been completely covered, give entire ship a coat of water and let stand until dry, this will stretch the paper so that it will become as taut as a drum. A coat of clear dope or banana oil is now applied. The motor cowls, landing gears, etc., should now be in position.

It might also be said here that the strength of a balsa propeller is also much increased by giving the propeller blades two or three heavy coats of dope. The dope binds the wood fibers together.

As we explained before, this model is an exceptionally good flyer in spite of the wing location. The average low-wing monoplane model tends to stall at the end of a flight, but such is not the case with this model.

END.

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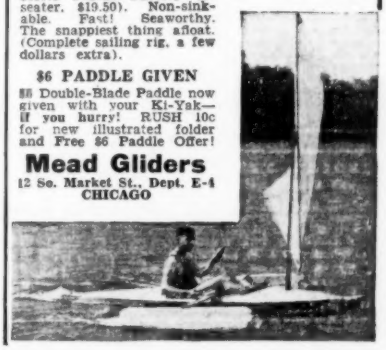

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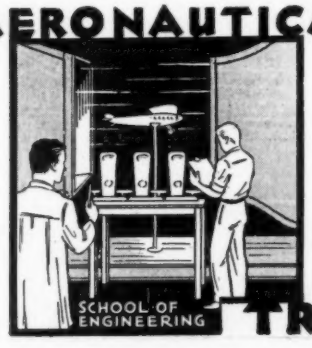

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The ANGLE-O-METER is an ideal instrument wherever blind flying is encountered, likewise invaluable to students in training due to the miniature airplane dial which simplifies instruction and offers greater confidence to the student.

Any person with the slightest mechanical ability can mount an ANGLE-O-METER. It requires but twenty or thirty minutes—(Airplane or glider).

The ANGLE-O-METER is fully guaranteed, and sent with complete instructions for mounting. A periodical adjustment of leveling device may be necessary every two years, and will be done by the manufacturers free of cost other than transit charges, provided the instrument has not been opened or serial number removed.

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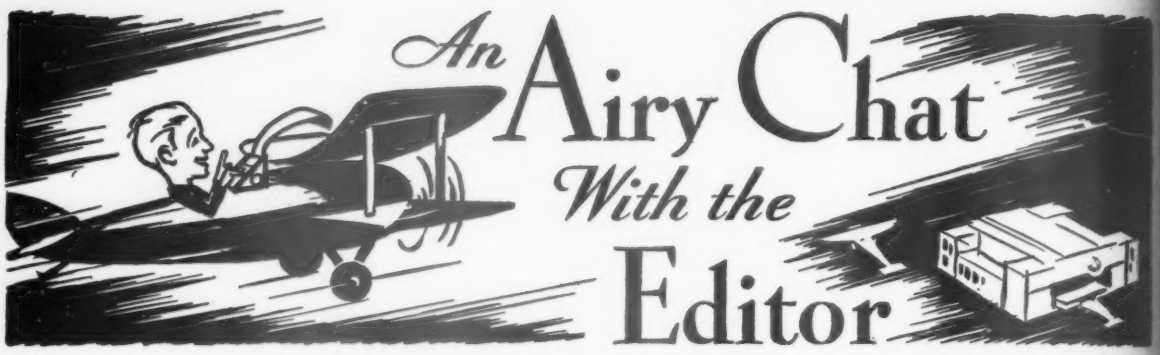

An Airy Chat With the Editor

AS we have repeatedly mentioned in these columns, commercial airlines under present conditions cannot make much of a profit on passenger carrying alone, nor from passengers and air-express combined. The profit, therefore, must be made from the air-mail.

The comparatively small volume of air-travel, together with the tremendous overhead charges, high salaries and cost of fuel with the present type of ship, prevents even fairly profitable operation without airmail when reasonable rates are made for passenger service. Therefore, if the commercial airlines are to be nurtured through their infancy, so as to insure a healthy normal growth of the industry, then some assistance must be given the corporate airlines by the distribution of airmail contracts to these operators.

* * *

UNDERSTANDING this, the various European governments have granted subsidies, gratuities, or whatever else you may wish to call them, to their airlines to assist them through an expensive period in their development. This was explained, only a short time ago, by an article appearing in POPULAR AVIATION.

But, in the United States, the technique of the political bodies is decidedly different. Instead of giving assistance, the main objective of our politicians is to cripple the airlines. They have recently attempted to tear down a structure that has taken years of effort and millions upon millions of dollars to establish. They have thrown pilots out of work, rendered our Air Corps effectively useless during this period and have cost investors millions and millions of dollars.

* * *

WELL, now that I have got that matter off my chest, we'll talk of pleasanter things—the coming transatlantic flights, for an example. Just what they expect to get out of hopping the briny again is rather obscure, but a number of pilots are getting ready to stage the annual salt-water carnivals and again court the favor of Lady Luck. Well, more power and better engines to them at any rate.

* * *

POPULAR AVIATION has added two new departments or series of articles, depending upon the way that you look at the matter. We hope that you will like them. Series No. 1 is the Aviation Engine Catechism consisting of instruction on the I-ask-you-and-you-tell-me idea. This series will cover all of the subjects ordinarily required by the Department of Commerce.

Series No. 2 is our new Patent Department which will show the latest patents issued by the U. S. Patent Office. Some of the patents are quite interesting and we therefore trust that this will meet with your approval. So far as possible, we will show only feasible patents of a practical nature and, preferably, "assigned patents" as accepted or purchased by well known manufacturers.

* * *

WHO is the big man in aviation, probably the biggest man in aviation today, who dry-smokes his pipe when conditions prohibit firing her up? Well, if you can't answer this question off-hand, just read about him in the following pages. He's the hard-hitting, hard-flying, hard-smoking Chief of the Army Air Corps, and his name is ——

* * *

POP AVIATION is running an article which we believe will be of interest to many of our readers, particularly to the Photo-Phans and model builders. This article treats of the development of the Curtiss "Hawk" series and the many types of this ship which have been experimented with or put into production. Some rare photographs of historic Hawks are shown.

* * *

THEY tell me that there is such a demand for good used airplanes today that the prices are going 'way up. This is a good sign of the times, for it will not be long before they will be ordering bunches of new planes and this will help out the industry a whole lot.

* * *

EVERYONE who can raise the price of a ship—almost any kind of a ship—is looking for a banner carrying job. You know what I mean, a ship towing a streamer in the rear reading, "Smoke Snookum's Best," or words to that effect. This is a good advertising stunt, if well organized, and should net the pilots a good profit.

YOU have to hand it to that man Granath who visited our office the other day in reply to our call in the Port of Missing Men. Mr. Granath is now jubilant over his success. He has just added another 20 horsepower to a Model "A" Ford engine by means of his variable compression device. He tells me that his converted Ford engine will now swing a prop at 2,400 r.p.m. that an OX5 has difficulty in swinging at 1,650 r.p.m.

* * *

DO you remember that article in the April issue concerning middle-aged men and their adaptability to aviation? Well, that article stirred up a lot of enthusiasm among the old-timers and has made a lot of them seriously consider a flight training course this summer. Just because he's bald is no reason why he's out of the game. Nossir!

* * *

A GREAT many men have worked on the flexible wing idea for a considerable period of time. The idea has always seemed practical and inviting, but strange to say, few of these ideas have been carried out to completion. And now we have Mr. Cornelius, who, after long years of labor, has succeeded in perfecting his automatically stable monoplane. This will be described in our next issue.

* * *

WE now have a new grade of license, the "Amateur Pilot's" license, which calls for 25 hours of solo flying time and which bridges the gap between the student pilot and the private pilot grades. Without being captious or presumptive, I think that the new grade should have been named the "Novice Pilot" rather than "Amateur Pilot" since neither the student pilot, amateur pilot nor private pilot are allowed to receive compensation.

* * *

THIS last idea came from a ruckus raised in radio circles several years ago. The amateurs of that time, who were really experts in the majority of cases, strenuously objected to being called beginners or having beginners listed as amateurs. Hence the word "novice" was introduced to differentiate between a beginner and the advanced amateur.

(*Concluded on page* 340)

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